CACHE CREEK OFF-CHANNEL AGGREGATE MINING PONDS – 2020 MERCURY MONITORING

FINAL Report

Monitoring and Report by

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fire year

TABLE OF CONTENTS

SUMMARY OF THE 2020 MONITORING AND ITS FINDINGS

- This Fall 2020 monitoring was the sixth year of fish mercury testing (Year 6) for four off-channel aggregate mining ponds, adjacent to lower Cache Creek between Capay and Woodland: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1 ponds. The monitoring was initiated in 2015. Three other ponds were added to the monitoring program in 2017: Teichert-Esparto–Mast, Teichert-Woodland–Storz, and Syar–West ponds. For these ponds, 2020 was Year 4 of mercury monitoring. The monitoring is required by Section 10-5.517 of the Yolo County Code, which was revised and updated in December 2019. That Ordinance requires 5 years of annual pre-reclamation mercury monitoring for mining ponds, and then bi-annual monitoring for 10 years following reclamation to permanent water bodies. The fish monitoring includes new sampling each year and assessment of mercury levels in relation to comparable baseline fish data from Cache Creek.

Fish Mercury Monitoring Summary – All Sites, 2015-2020

Pit Sites	2015	2016	2017	2018	2019	2020
Cemex – Phase 1	≤	≤	≤	≤	≤	≤
Cemex – Phase 3-4	>	>	>	>	>	≤
Teichert-Esparto – Reiff	INC	>	>	>	>	>
Teichert-Esparto – Mast			>	INC	>	>
Teichert-Woodland – Storz			INC	≤	≤	≤
Syar – B1	>	>	>	>	>	>
Syar – West			>	≤	>	>

≤ = at or below ambient INC = inconclusive > = elevated over ambient

- As summarized in the table above, the Cemex–Phase 3-4, Teichert–Esparto, Syar–B1, and Syar–West pits have had "three or more years out of five elevated over the ambient". The program requires that the County take certain steps following a third year in five of exceedance for a pit:

  – Require an additional <u>five years of fish mercury monitoring and water column profiling</u>. This pattern will continue until a lake is found to be at or under the ambient for a five-year period; the regulations also allow the County to require continued monitoring during mining. Comparison monitoring during this time will also be conducted at control/reference sites.

  – Require <u>Expanded Analysis</u> – including expanded water column profiling of all relevant water quality parameters (multiple times per year rather than a single time per year) and one-time bottom sediments analysis. Expanded analyses, as set out in the Ordinance, began in 2018 and are reported separately – see summary status tables of these activities at the end of this section.

– Once the reports are completed, the County will notify individual operators of results in individual ponds that require Lake Management Plans (LMPs). The information in the fish monitoring, water column profiling, and bottom sediments reports will then be used to identify mercury control methods to reduce fish mercury levels and prepare required LMPs.

– Implementation of the LMP is required within three years of completion of the expanded monitoring. Management controls may differ for different pits based on site conditions; and may differ during mining, while idle, and post-mining. LMPs may be multi-part or phased to reflect this. Fish monitoring and water column profiling will continue, per the regulations, for a minimum of five more years. Required periodic analysis of ambient conditions will also continue.

- For environmental mercury, fish consumption is by far the most significant exposure route for people and wildlife. Fish also provide an accurate measure of relative mercury exposure levels over time, and for comparison between ponds and Cache Creek. For these reasons, the mercury monitoring program for Yolo County aggregate mining ponds focuses on fish.

- A variety of collection techniques were used to obtain samples of the fish found in each of these ponds, including seines, gill nets, baited setlines, dip nets, and angling. Large, angling-sized fish were tested individually for fillet muscle mercury, relevant to human consumption. Small, young, "biosentinel" fish were analyzed whole-body, relevant to wildlife consumption and inter-annual comparisons, in replicate multiple-individual composite samples.

- Samples of both large and small fish of multiple species, as available, were collected from all six of the identified ponds (in their current configurations). A total of 175 adult, angling-sized fish (mainly bass) were sampled individually for fillet muscle mercury analysis in this 2020 monitoring. Additionally, a total of 426 small, young, biosentinel fish were split into 61 multi-individual, whole fish composite samples by site, species, and size. These were also analyzed for mercury.

- The new 2020 data are compared with results from 2015-2019, and with the most closely corresponding 'baseline' and historic fish collections conducted previously in Cache Creek (from the stretch of creek within the planning and aggregate-mining area). As in prior years, the ponds sampled in Fall 2020 were found to show distinct, individual mercury signatures that were broadly consistent across the different fish types tested.

- **Cemex – Phase 1 Pond:** Twenty adult Largemouth Bass were sampled, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. The Cemex–Phase 1 Pond remained one of the lowest mercury ponds of the sites being monitored. Concentrations in 2020 were statistically similar to or lower than corresponding baseline Cache Creek samples of same or similar species and sizes. The Phase 1 Pond was therefore not found to be "elevated in three or more years of five" and did not trigger seasonal water column profiling and consideration of mercury management. However, the overall low mercury status of this pond, and the fish mercury trends over the years monitored in relation to operations changes, made it a key comparison for management insights for the elevated ponds. It was chosen as a control/reference site, as required for the "expanded analysis" parts of the monitoring, and has been part of that work since 2018.

- **Cemex – Phase 3-4 Pond:** Twenty adult Largemouth Bass were sampled, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Green Sunfish, and juvenile Largemouth Bass. Mercury levels were down from the year before (2019), which in turn had come down from the peak levels found here before 2019. Overall fish mercury at this pond in 2020 was, for the first time, not elevated over comparable creek baseline samples, for all sample types with enough numbers to compare. However, because it was earlier found to be "elevated for three or more years of five" over creek baselines (2015-2019, all 5 years), that triggered the addition of "expanded analysis" and development of a mercury management plan. Expanded analysis work began here in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports.

- **Teichert – Esparto Pond:** Before the 2020 sampling season, the previously separate Reiff and Mast Ponds were combined by Teichert into a single large Esparto Pond, by excavating parts of dividing levees. Monitoring continued in the combined pond in 2020. As in prior years in Reiff Pond, several large fish species were present; samples were taken of adult Largemouth Bass (13), White Catfish (10), and Common Carp (7). Small, young-of-year fish were also collected, with multiple composite samples of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. The adult fish samples averaged a decline in mercury levels from last year, continuing a recent trend. The small, young fish (more representative of recent conditions) showed a reversing trend though, with higher levels in 2020. Despite the relative ups and downs, this site remained highly elevated in mercury in 2020. All of the fish sample types averaged significantly higher mercury than corresponding Cache Creek baseline samples; the Teichert-Esparto Pond remained in the "elevated over baseline" category in 2020. Similar results from previous years in the Reiff and Mast ponds triggered the collection of additional information ("expanded analysis") to help guide development of a mercury management plan. Water column profiling and collection of bottom sediment samples began in May 2018 and are the subject of accompanying reports.

- **Teichert-Woodland – Storz Pond:** A sample of 20 small adult bass (the prevailing size) was taken, together with multiple composite samples of young-of-year Mosquitofish and juvenile Largemouth Bass. Adult bass showed a further drop in mercury levels in 2020, after decreasing in 2019 from already non-elevated concentrations. Across all sample types, fish mercury was the lowest here among the six monitored ponds. Relative to Cache Creek comparison data, Storz Pond continued to rank as "not elevated over baseline" in 2020 and is not flagged for expanded analysis or management planning. One-time-per-year routine water profiling has been added to the monitoring, following recent revisions of the mining ordinance.

- **Syar – B1 Pond:** Nineteen adult Largemouth Bass were sampled, and ten adult Bluegill Sunfish. Young-of-year small fish collections included composites of Mosquitofish, juvenile Largemouth Bass, and juvenile Bluegill Sunfish. Adult fish mercury rose slightly over 2019 (not significantly) but remained significantly lower than the peak levels found here in 2015-2016.

Small fish samples all showed a decline. Despite the relative drop in recent years, B1 Pond fish mercury in 2020 was still significantly higher on average than most baseline Cache Creek comparisons. Because of the overall status of the B1 Pond as "elevated over baseline in three or more years of five" (all years since 2015), water column profiling and collection of bottom sediments was started here in 2018, in support of the development of a lake management plan. That work is detailed in accompanying reports.

- **Syar – West Pond:** Nineteen adult Largemouth Bass were sampled, and ten adult Bluegill Sunfish. Young-of-year small fish collections included multiple composites of Mosquitofish and juvenile Bluegill Sunfish. On average, the 2020 fish Syar-West were significantly elevated over baseline in 2020, as in 2017 and 2019. That makes "three or more years of five elevated over baseline" as specified in the Ordinance, triggering the requirement for expanded analysis and development of a lake management plan. Expanded analyses have in fact been conducted here since 2018, as a second control/reference site. This pond is far deeper than the other ponds and is representative of the range of final depths projected at several of the sites. With elevated fish mercury status as of 2020, this work will help in the development of a lake management plan.

Status of Other Components of the Mercury Monitoring Program

Water Column Profiling *(elevated sites and controls)*

Pit Sites	2015	2016	2017	2018	2019	2020
Cemex – Phase 1 *(control)*				✓	✓	✓
Cemex – Phase 3-4				✓	✓	✓
Teichert-Esparto – Reiff				✓	✓	✓
Teichert-Esparto – Mast						
Teichert-Woodland – Storz						
Syar – B1				✓	✓	✓
Syar – West *(deep control)*					✓	✓

Bottom Sediment Collections *(single event, elevated sites and controls)*

Pit Sites	2015	2016	2017	2018	2019	2020
Cemex – Phase 1 *(control)*				✓		
Cemex – Phase 3-4				✓		
Teichert-Esparto – Reiff				✓		
Teichert-Esparto – Mast						
Teichert-Woodland – Storz						
Syar – B1				✓		
Syar – West *(deep control)*				✓		

Reports Completed

Report	2015	2016	2017	2018	2019	2020
Fish Mercury Monitoring	Final	Final	Final	Final	Final	Draft
Water Column Profiling				Final	Final	Draft
Bottom Sediments (1x)				Final		

INTRODUCTION

This monitoring was conducted for Yolo County in the summer and fall of 2020, to provide ongoing fish mercury information from a set of aggregate mining ponds located adjacent to lower Cache Creek. The monitoring was triggered by Section 10.5.517 of the Yolo County Surface Mining Reclamation Ordinance (Yolo County Code), which was enacted originally in 1996. Earlier reports (2015-2018) have gone into detail about the County's history with the mercury issue, placing the first years of monitoring into context with the 1996 Ordinance. In December 2019, the County adopted a comprehensive update to the Cache Creek Area Plan (CCAP), which included a full revision of this code section (Yolo County Code 2019), incorporating new findings and issues identified since 1996. Mercury monitoring and reporting since then, including this 2020 report, complies with the updated ordinance requirements. The complete 2019 Ordinance is attached, as Appendix A, at the end of this report. Below, in this introduction, parts that most directly affect this fish mercury monitoring program are excerpted and discussed. Ordinance text is shown in ***bold italics***, with discussion in plain text.

Yolo County, CA Code of Ordinances, Sec. 10-5.517
Dec 2019 Revision – Mercury Bioaccumulation in Fish.

As part of each approved long-term mining plan involving wet pit mining to be reclaimed to a permanent pond, lake, or water feature, the operator shall maintain, monitor, and report to the Director according to the standards given in this section. Requirements and restrictions are distinguished by phase of operation as described below.

(a) MERCURY PROTOCOLS. The Director shall issue and update as needed "Lower Cache Creek Off-Channel Pits Mercury Monitoring Protocols" (Protocols), which shall provide detailed requirements for mercury monitoring activities. The Protocols shall include procedures for monitoring conditions in each pit lake, and for monitoring ambient mercury level in the lower Cache Creek channel within the CCAP planning area, as described below.

Mercury Protocols for these tasks were developed before the monitoring program began in 2015 and were followed through 2019. The protocols were revised, expanded, and updated (Slotton 2021) to support the 2019 revision of the County Code Ordinance.

(b) AMBIENT MERCURY LEVEL. The determination of the ambient or "baseline" fish mercury level shall be undertaken by the County every ten years in years ending in 0. This analysis shall be undertaken by the County for use as a baseline of comparison for fish

mercury testing conducted in individual wet mining pits.
The most recent creek sampling targeted to the aggregate mining zone was conducted in 2011 and 2012 (Slotton and Ayers 2013). Data from other earlier studies that coincidentally fell within the planning area have also been used for comparisons. Another full Cache Creek Baseline set of fish collections will be conducted some time in the next few years. Collections were planned for 2020 but were put off because of major fires in the area.

(c) PIT MONITORING.

(1) Mining Phase (including during idle periods as defined in SMARA). The operator shall monitor fish and water column profiles in each pit lake once every year during the period generally between September and November for the first five (5) years after a pit lake is created. Fish monitoring should include sport fish where possible, together with other representative species that have comparison samples from the creek and/or other monitored ponds. Sport fish are defined as predatory, trophic level four fish such as bass, which are likely to be primary angling targets and have the highest relative mercury levels. The requirements of this subsection apply to any pit lake that is permanently wet and navigable by a monitoring vessel.
This monitoring began in 2015, at four aggregate mining ponds: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. Three other ponds were added to the monitoring program in 2017: Teichert-Esparto–Mast, Teichert-Woodland–Storz, and Syar–West ponds. In 2020, Reiff and Mast were combined into a single Teichert–Esparto Pond, making six monitored ponds in total at this time. An important focus of the monitoring has been largemouth bass, which are present in most of the ponds.

If, in the initial five (5) years after the pit lake is created, the applicable response threshold identified in subsection (e) is exceeded in any three (3) of five (5) monitoring years, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).
Before the 2020 monitoring, three of the six ponds were found to have fish mercury above baseline creek comparison levels in three or more years of five: Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. Beginning in 2018, "expanded analysis" testing was initiated at these three ponds, and also at Cemex–Phase 1 as a required lower mercury control/reference site (see (f)(1)) and at Syar–West as a deep pond control. The expanded analyses have included one-time sediment testing and seasonal, ongoing water column profiling as specified in Section (f). This work is in the data gathering stage. Findings are intended to help guide the preparation of realistic lake management plans.

For future, post-mining years: monitoring and potential lake management requirements:

(2) Reclamation Phase. No monitoring is required after mining has concluded, during the period that an approved reclamation plan is being implemented, provided reclamation is completed within the time specified by SMARA or the project approval, whichever is sooner.

(3) Post-Reclamation Phase. After reclamation is completed, the operator shall monitor fish and water column profiles in each pit lake at least once every two (2) years during the period of September-November for ten (10) years following reclamation. Monitoring shall commence in the first calendar year following completion of reclamation activities. If fish monitoring results from the post-reclamation period exceed the applicable response threshold described in subsection (e) or, for ponds that have implemented mitigation management, results do not exhibit a general decline in mercury levels, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(4) Other Monitoring Obligation. If monitoring conducted during both the mining and post-reclamation phase did not identify any exceedances of the ambient mercury level for a particular pit lake, and at the sole discretion of the Director no other relevant factors substantially support that continued monitoring is merited, the operator shall have no further obligations.

(e) RESPONSE THRESHOLDS.

(1) Fish Consumption Advisory. If at any time during any phase of monitoring the pit lake's average sport fish tissue mercury concentration exceeds the Sport Fish Water Quality Objective (as of 2019, the level was 0.2 mg/kg), the operator shall post fish consumption advisory signs at access points around the lake and around the lake perimeter. Catch-and-release fishing may still be allowed.
The sites have been posted. Catch and release fishing has been common at the Syar ponds and not at the others.

(2) Mining Phase Results. If, during the mining phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three (3) of five (5) monitoring years, annual monitoring shall continue for an additional five (5) years, and the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).
Fish monitoring has continued at all pit lakes found to be elevated in fish mercury, and at those still in the initial five years of testing. As noted above in (c)(1), expanded analysis is in progress at the identified elevated mercury sites and control/reference ponds, gathering data to help develop lake management plans.

For future, post-mining years: monitoring and potential lake management requirements:

(3) Post-Reclamation Phase Results. If during the first ten (10) years of the post-reclamation phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three (3) of five (5) monitoring years, biennial monitoring shall continue for an additional ten (10) years, and the operator shall undertake expanded analysis pursuant to subsection(f) and preparation of a lake management plan pursuant to subsection (g).

(f) EXPANDED ANALYSIS.

(1) General. If, during the mining or post-reclamation phase, any pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three (3) years, the operator shall undertake expanded analyses. The analysis shall include expanded lake water column profiling (a minimum of five profiles per affected wet pit lake plus one or more nonaffected lakes for control purposes) conducted during the warm season (generally May through October) in an appropriate deep profiling location for each pit lake. The following water quality parameters shall be collected at regular depth intervals, from surface to bottom of each lake, following protocols identified in subsection (a): temperature, dissolved oxygen, conductivity, pH and oxidation-reduction potential (ORP), turbidity or total suspended solids, dissolved organic matter, and algal density by Chlorophyll or Phycocyanin. The initial analysis shall also include one-time collections of fine grained (clay/silt) bottom sediments from a minimum of six well distributed locations for each affected lake, and from one or more non-affected lakes for control purposes, to be analyzed for mercury and organic content.

The current expanded analysis work is guided by these directions. Data gathering on these various, potentially important parameters is underway; 2020 data are presented in the companion report on water profiling.

(2) Scope of Analysis. The purpose of the expanded analyses is to identify and assess potential factors linked to elevated methylmercury production and/or bioaccumulation in each pit lake. In addition to the analyses described in subsection (f)(1) above, the analysis should also consider such factors as: electrical conductivity, bathymetry (maximum and average depths, depth-to-surface area ratios, etc.), and trophic status indicators (concentrations, Secchi depth, chlorophyll a, fish assemblages, etc.). Additional types of testing may be indicated and appropriate if initial results are inconclusive.

These suggestions are all being followed in the expanded analysis work.

(3) Use of Results. The results of the expanded analyses undertaken pursuant to this subsection shall be used to inform the preparation of a lake management plan described below under subsection (g).

As noted above, this work is in the data gathering stage. Findings are intended to help guide the preparation of realistic lake management plans. This, and future management and monitoring activities, are described in these final Ordinance excerpt sections:

(g) LAKE MANAGEMENT ACTIVITIES.

(1) General. If monitoring conducted during the mining or post-reclamation phases triggers the requirement to undertake expanded analysis and prepare and implement a lake management plan, the operator shall implement lake management activities designed by a qualified aquatic scientist or equivalent professional acceptable to the Director, informed by the results of subsection (f). Options for addressing elevated mercury levels may include (A) and/or (B) below at the Director's sole discretion and at the operator's sole expense.

(A) ***Lake Management Plan. Prepare a lake management plan that provides a feasible, adaptive management approach to reducing fish tissue mercury concentrations to at or below the ambient mercury level. Potential mercury control methods could include, for example: addition of oxygen to or physical mixing of anoxic bottom waters; alteration of water chemistry (modify pH or organic carbon concentration); and/or removal or replacement of affected fish populations. The lake management plan may be subject to external peer review at the discretion of the Director. Lake management activities shall be appropriate to the phase of the operation (e.g., during mining or post-reclamation). The Lake Management Plan shall include a recommendation for continued monitoring and reporting. All costs associated with preparation and implementation of the lake management plan shall be solely those of the operator. Upon acceptance by the Director, the operator shall immediately implement the plan. The lake management plan shall generally be implemented within three years of reported results from the expanded analyses resulting from subsection (f). If lake management does not achieve acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator may prepare an alternate management plan with reasonable likelihood of mitigating the conditions.***

(B) Revised Reclamation Plan. As an alternative to (A), or if (A) does not achieve acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator shall prepare and submit revisions to the reclamation plan (including appropriate applications and information for permit amendment) to fill the pit lake with suitable fill material to a level no less than five (5) feet above the average seasonal high groundwater level, and modify the end use to agriculture, habitat, or open space at the discretion of the Director, subject to Article 6 of the Mining Ordinance and/or Article 8 of the Reclamation Ordinance as may be applicable.

(2) IMPLEMENTATION OBLIGATIONS.

(A) If a lake management plan is triggered during the mining or post-reclamation phase and the subsequent lake management activities do not achieve acceptable results and/or demonstrate declining mercury levels, the operator may propose

different or additional measures for consideration by the Director and implementation by the operator, or the Director may direct the operator to proceed to modify the reclamation plan as described in subsection (g)(1)(B).

(B) Notwithstanding the results of monitoring and/or lake management activities during the mining phase, the operator shall, during the post-reclamation phase, conduct the required ten years of biennial monitoring.

(C) If monitoring conducted during the post-reclamation phase identifies three monitoring years of mercury concentrations exceeding the ambient mercury level, the operator shall implement expanded analyses as in subsection (f), to help prepare and implement a lake management plan and associated monitoring.

(D) If subsequent monitoring after implementation of lake management activities, during the post-reclamation phase, demonstrates levels of fish tissue mercury at or below the ambient mercury level for any three monitoring years (i.e., the management plan is effective), the operator shall be obligated to continue implementation of the plan and continue monitoring, or provide adequate funding for the County to do both, in perpetuity.

As fish have been found to be the most straightforward, clear measure of methylmercury exposure and bioaccumulation in aquatic systems, this monitoring focuses on fish. All six of the currently identified ponds (Table A, Figure A) were monitored for fish mercury in 2020. Four of the ponds have been monitored since 2015 and, for them, this was Year 6 of sampling: Cemex–Phase 1, Cemex–Phase 3-4, Teichert–Esparto (formerly Reiff and Mast), and Syar–B1. Two additional ponds were added to the monitoring in 2017; for these, 2020 was Year 4: Teichert-Woodland–Storz, and Syar–West. Both large and small fish samples of multiple species, as available, were collected and analyzed from each of the ponds.

The purpose of this report is to present the new 2020 fish mercury data from the tested aggregate mining ponds and, for each pond, to compare levels to similar baseline samples taken from the planning area of Cache Creek in 2011-2012 and in earlier studies. A key objective is to help the mining operators and Yolo County determine if specific pond sites are falling below, at, or above fish mercury concentrations found in adjacent Cache Creek. This will help guide future reclamation and, if necessary, pond management.

The factors that influence the production of methylmercury and its uptake by fish are complex and can change from one year to the next, often leading to a range of fish mercury levels over time rather than some absolute value. Because of this, the Ordinance states that multiple years of data are needed to make assessments. Therefore, another objective is to compare this year's data (2020) with monitoring results found at the same sites in the previous monitoring years (2015-2019).

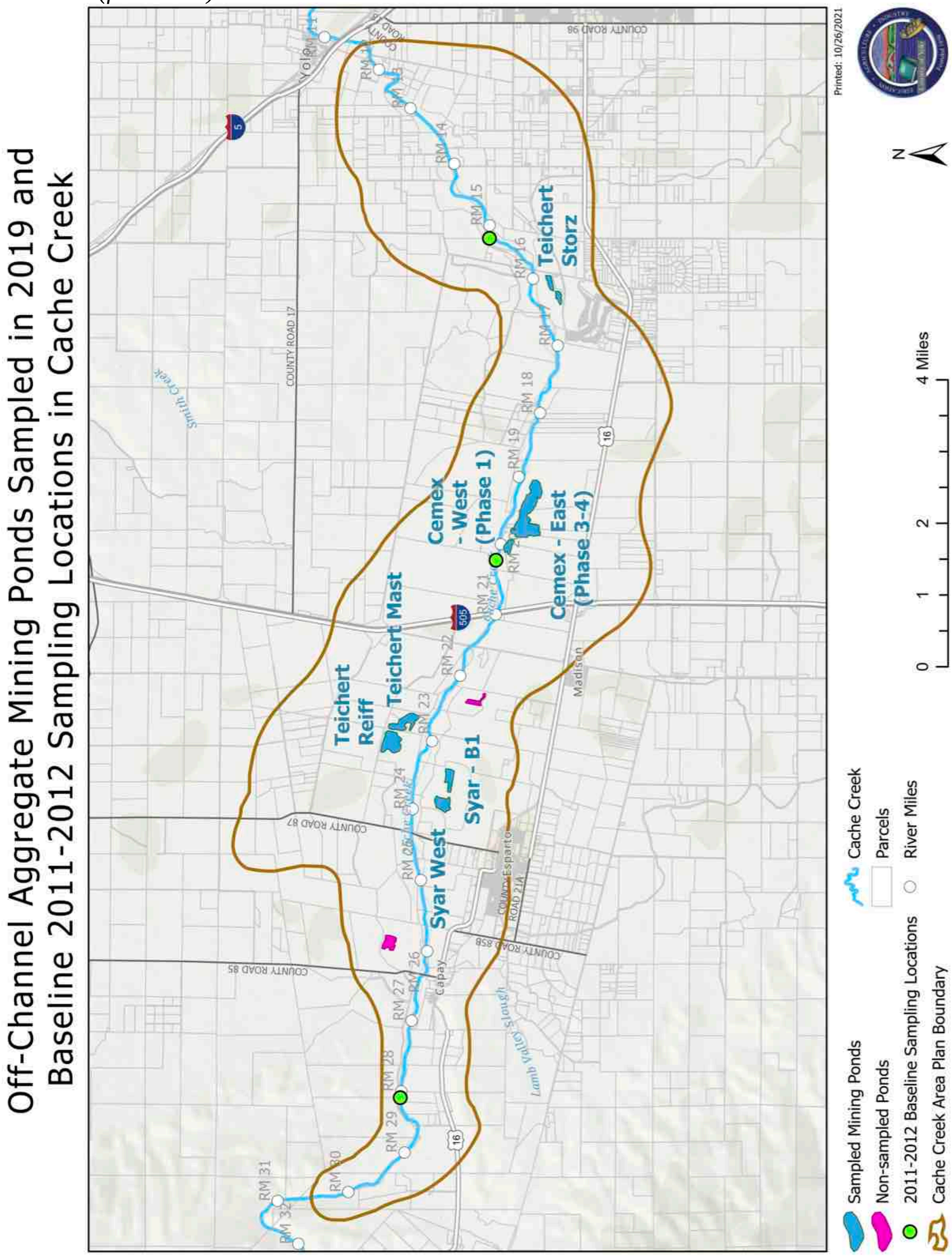
In the sections below we will discuss the methods used, followed by a presentation of the 2020 fish mercury data, by individual pond site. Each data table is accompanied by a matching figure with the same number that graphically shows the information. For each site, we first present the analytical results from each individual large fish sample and each small fish composite sample. Then we show the new data in reduced form (means, error bars, etc.) for each sample type and compare to 2015-2019 same-site findings and the most closely comparable historic creek data. For creek comparisons, we are focusing on historic data specifically from the planning / aggregate-mining section of the creek, roughly between River Mile 28 (below the Capay diversion dam) and River Mile 15 (app. 1 km below County Road 94B). In particular, these include the 2011 Baseline collections from River Mile 15 (RM15), RM20, and RM28, which were conducted specifically to provide comparable samples for the pond monitoring. In the data tables and figures, the 2011 Baseline comparison data are highlighted with bold text and outlines. Additional historic sampling that was coincidentally done within the planning region of Cache Creek includes a project around the Cache Creek Nature Preserve in 2000-2006 (RM15 and RM17 small fish) and a CalFed 1998-2000 UC Davis study of the entire Cache Creek watershed that included some fish collections in the study zone.

After individual reporting sections for each pond, a final data section consolidates summary results for each fish type, from all the sites and baseline creek samples for easy comparison. In the Discussion/Conclusions, the available pond data to-date are placed into the context of the updated Yolo County Ordinance, with next steps and recommendations. Appendix A includes the full text of the new Ordinance. Appendix B has photos of the Fall 2020 fish mercury monitoring work.

Table A. Wet Pits Subject to Annual Mercury Monitoring
(modified from Yolo County Exhibit C)

Operator	Site	Pit	Year Mining Crossed Water Table (app)	End Reclamation Plan	Year Monitoring Began	Monitoring Year in Fall 2020
Cemex	Madison	**Phase 1**	< 1996	Lake and habitat	2015	Year 6
Cemex	Madison	**Phase 3-4**	≤ 2002	Lake and habitat	2015	Year 6
Teichert	Esparto	**Reiff**	≤ 2002	Lake and habitat	(2015-2019)	
Teichert	Esparto	**Mast**	2007-2008	Lake and habitat	(2017-2019)	
		(Reiff and Mast were combined into one pond in 2020)				
Teichert	Esparto	**Esparto**				(Year 6)
Teichert	Woodland	**Storz**	2010-2011	Lake and habitat	2017	Year 4
Syar	Madison	**B1**	≤ 2002	Lake and habitat	2015	Year 6
Syar	Madison	**West**	≤ 2002	Lake and habitat	2017	Year 4

Figure A. Map of aggregate mining ponds and Cache Creek baseline monitoring locations *(from 2019)*



METHODS

Field sampling was coordinated with staff of the three mining companies: Teichert, Cemex, and Syar. Access ramps for boat launching were constructed at some of the ponds, which was a big help. We used our sampling boat to move around each of the ponds and collect the fish.

The fish samples were taken with a variety of techniques. Adult fish were collected with gill nets in a range of mesh sizes, also with baited set lines laid at the bottom of ponds (catfish), and by angling (bass). Gill nets and set lines, deployed in both daylight and nighttime conditions, were carefully monitored to remove captured fish, to minimize unnecessary mortality. Small, young fish samples were collected with a variety of seines and hand nets.

Large fish were field identified, weighed and measured, and sampled for mercury analysis using a non-destructive biopsy technique we developed that allows us to return the fish back to the water in good condition (Slotton et al. 2002). In this technique, numbered sample vials are pre-weighed, empty, to 0.0001 g accuracy. In the field, several scales are removed from each fish on the left side above the lateral line and a small biopsy sample of app. 0.200 g (about the size of a small raisin) is taken of the fillet muscle. The sample is carefully placed into a pre-weighed vial. Vials are closed with sealing screw-tops and stored on ice in a protective vial box. Later, at the laboratory, the vials with sample pieces are again weighed and the exact weight of each sample is determined by subtracting the empty tube weight.

Small young-of-year fish, in contrast, were sacrificed for analyses, analyzed whole. Small fish were field identified, cleaned and sorted by species, bagged in labeled freezer-weight, zip-close bags with air removed, and transported on ice to the laboratory. Fish were then weighed, measured, and assembled into composite groupings of similar-sized fish for each size class. Each composite sample was frozen in doubled freezer-weight bags with water surrounding and air removed, a technique our group has found to maintain natural moisture levels through the freezing process, something that can be a major problem for small fish samples (Slotton et al. 2015). Pre-analytical processing included weighing and measuring the fish in each composite group and drying the sample to constant weight in a laboratory oven at 55 °C. Solids percentage was calculated during this process, through sequential weighings of empty weigh pans, pans with wet sample, and pans with dry sample. Dried samples were later homogenized to fine powders using a laboratory grinder.

Large fish fillet muscle samples were analyzed for mercury directly, on a wet (fresh) weight basis. Small fish composite samples were analyzed whole body, homogenized into dry powders for consistency, as described above. Dry weight results were converted to original wet/fresh weight concentrations using the calculated percentage solids values. Beginning in 2020, mercury analyses shifted from a concentrated acid digestion and Perkin-Elmer Flow Injection Mercury System (FIMS) to a new, state-of-the-art direct mercury analyzer system (Milestone DMA-80 evo), using EPA Method 7473.

As with the previous methods, extensive Quality Assurance / Quality Control (QA/QC) samples were included in all analytical runs and tracked with control charts. These included, for each 20 field samples: 3 method blanks, 3 standard reference materials with certified levels of mercury, 2 aqueous calibration samples, a laboratory duplicate, a spiked field sample, a spike duplicate, and 3 continuing calibration samples. For initial machine calibration, the previous method used an 8 point aqueous standard curve for each daily run. The new system retains stability for over a month; an extensive calibration was performed each month, using at least 15 aqueous calibration solutions, each run in duplicate. Calibration stability was tested each analytical run with the many aqueous and solid reference samples. QA/QC Results for this project were all well within control limits.

2020 FISH MERCURY MONITORING RESULTS

1. CEMEX – PHASE 1 POND

(Google Earth 10/21/20)

1. CEMEX–PHASE 1 POND *(Tables and Figures 1-8)*

Summary

Twenty adult Largemouth Bass were sampled, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. Despite some relative ups and downs over the years, the Cemex–Phase 1 Pond remained one of the lowest in fish mercury of the ponds being monitored. Concentrations in 2020 were statistically similar to or lower than corresponding baseline Cache Creek samples of same or similar species and sizes. The Phase 1 Pond was therefore not found to be "elevated in three or more years of five" and did not trigger seasonal water column profiling and consideration of mercury management. However, the overall low mercury status of this pond, and the interesting changes over the years monitored in relation to operations changes, made it a key comparison for management insights for the elevated ponds. It was chosen as a control/reference site, as required for the "expanded analysis" parts of the monitoring, and has been part of that work since 2018.

Summary 2020 Cemex – Phase 1 Results, in relation to baseline comparisons

≤ = at or below ambient   INC = inconclusive   > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	≤	≤	Largemouth Bass
		≤	Mosquitofish
		≤	Sunfish
Overall 2020 Findings	≤		

This pond is the oldest of the current Cemex ponds, dating from the 1990s. It is located just south of Cache Creek and east of Highway 505. The Phase 1 Pond is an oval shaped bowl that is approximately 400 m long and 150 m wide. In 2020, depths ranged narrowly between 5.5 and 6.3 m (18-21 feet). This pond went through some changes over the years of monitoring. Active mining was still underway here in 2015. In 2016 there was little or no mining in the pond itself, but it continued to receive the silt and clay slurry effluent of the general plant operations, so the water was very turbid. In 2017, active mining was on hold at both Cemex ponds, so there was less slurry effluent to the Phase 1 Pond. Since 2018, active mining resumed at the Phase 3-4 Pond, with process slurry effluent discharging to the Phase 1 Pond, generally keeping this shallow pond turbid. This (2020) was Year 6 of monitoring at this site.

We sampled the pond during day, twilight, and night conditions with a range of techniques, and were able to obtain samples of the fish species available. Large, angling-sized fish taken were: 20 Largemouth Bass (*Micropterus salmoides*). Despite fishing effort for other species, they have not been found since 2018. In previous years, we routinely took several Channel Catfish (*Ictalurus punctatus*) and White Catfish (*Ameiurus catus*). We suspect that these may have been fished out of the system (not by us; we always return biopsy-sampled fish back to the ponds in good condition). The small fish present were Mosquitofish (*Gambusia affinis,* 1-2"), juvenile Green Sunfish (1-3"), and juvenile Largemouth Bass (3-5"). Three to five multi-individual composite samples were analyzed from each of these small fish species as available, for 13 total composites.

In total, this added up to 20 large fish muscle samples and 13 composite small fish samples, 33 separate fish mercury samples, analyzed from the Cemex–Phase 1 Pond in the Fall 2020 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 1 and, graphically, in Figure 1. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2019 results and the most closely comparable historic creek data (Tables 2-4, Figures 2-4). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 5-8.

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Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 1 and 2)

The 2020 bass samples ranged in size between 214 and 338 mm (about 8-13"). Adult Bass represent the top predator fish in this region and will typically have the highest mercury levels at any given site. Mercury concentrations generally increased with fish size, as is typical. The 2020 samples had fillet muscle mercury ranging from 0.157-0.796 ppm, averaging 0.352 ppm. This was down from 2019 (0.404 ppm) and 2018 (0.481 ppm); the difference was not significant, statistically similar to all previous years. As compared to baseline/historic samples from Cache Creek, the 2020 Phase 1 adult Largemouth Bass were not elevated in mercury; they were lower than 6 of 7 similar baseline/historic sample sets from Cache Creek; the difference was statistically significant for three of the comparisons. As noted in previous reports, the Phase 1 bass were among the lower mercury top predator fish samples we have collected in California, across many studies. Although the overall concentrations remained relatively low, the changes seen between 2015 and 2020 provide evidence of some of the factors influencing fish mercury exposure in the aggregate mining ponds. The changes in bass mercury uptake corresponded to changes in mining practices at this site: from active mining plus slurry inputs, to slurry only, to no mining or slurry and, after 2018, back to slurry inputs.

Channel Catfish / White Catfish (Table/Figure 3)

No adult catfish were found in 2020. Data from previous years are shown.

Green Sunfish (Table/Figure 4)

No adult Green Sunfish were found in 2020. Data from previous years are shown.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 5 and 6)

This year, we we collected 17 juvenile bass. These were divided into five size-class composite samples of 2-4 fish each. These whole-body composites had uniformly low mercury levels of 0.086-0.126 ppm, with a mean of 0.104 ppm. Levels have been consistently low at this pond, across the six years monitored to this point. Within this range of relatively low juvenile bass mercury concentrations, the 2020 set were in the mid-range of the long-term data. They were statistically lower in 2020 (0.104 ppm) than 2017 (0.146 ppm), statistically similar to collections from 2016 (0.094 ppm) and 2019 (0.114 ppm), and statistically higher than samples from 2015 (0.044 ppm) and 2018 (0.068 ppm, single fish). Within each year, variability was very low, allowing statistical differentiations between years and with comparative creek samples. Relative to baseline Cache Creek comparison fish, the 2020 Phase 1 juvenile Largemouth Bass were, on average, not elevated; they were significantly lower in mercury than the River Mile 28 set and significantly above the River Mile 15 set.

Mosquitofish (Tables/Figures 5 and 7)

Mosquitofish were sampled with four ascending size-class sets of 12 individuals each. These multiple-fish composites had whole-body mercury ranging from 0.058-0.165 ppm, averaging 0.096 ppm. The six-year trend is very similar to that in the juvenile bass: levels gradually increased between 2015 and 2017 (0.075-0.135 ppm), dropped significantly in 2018 (0.083 ppm), and rose somewhat in 2019 and 2020 (not significantly). The 2020 set remained significantly lower than the 2017 fish, and statistically similar to all the other years. As in previous years and at the other sites, this species was more variable within each year than the juvenile bass, showing an increase in mercury with Mosquitofish size. This broadened statistical confidence intervals of the means, leading to more overlap statistically. Relative to the creek baseline comparisons, the 2020 Phase 1 Mosquitofish were not elevated; mean mercury was statistically similar to both River Mile 15 comparisons (0.100-0.103 ppm) and significantly lower than the River Mile 17 sets (0.178 ppm).

Juvenile Green Sunfish (Tables/Figures 5 and 8)

The juvenile Green Sunfish composites had whole-body mercury ranging from 0.070-0.108 ppm, averaging 0.089 ppm, identical to last year. This species, collected since 2017, was generally consistent with the other two small fish species: highest levels were seen in 2017 (0.118 ppm), lowest in 2018 (0.035 ppm), and a relative increase to an intermediate level in 2019 and 2020 (0.089 ppm). These broad changes were statistically significant, though all were relatively low levels. As compared to the creek baseline samples, the 2020 Phase 1 juvenile Green Sunfish were not elevated; levels were statistically similar to two of five comparisons and significantly lower than three.

Table 1. Cemex – Phase 1 Pond: Individual large fish sampled, 2020

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	214	8.4	135	0.3	**0.194**
Largemouth Bass	228	9.0	165	0.4	**0.157**
Largemouth Bass	228	9.0	160	0.4	**0.183**
Largemouth Bass	237	9.3	185	0.4	**0.207**
Largemouth Bass	241	9.5	180	0.4	**0.194**
Largemouth Bass	258	10.2	212	0.5	**0.464**
Largemouth Bass	259	10.2	215	0.5	**0.239**
Largemouth Bass	262	10.3	225	0.5	**0.240**
Largemouth Bass	265	10.4	190	0.4	**0.459**
Largemouth Bass	268	10.6	265	0.6	**0.234**
Largemouth Bass	268	10.6	235	0.5	**0.334**
Largemouth Bass	271	10.7	240	0.5	**0.382**
Largemouth Bass	276	10.9	285	0.6	**0.315**
Largemouth Bass	276	10.9	265	0.6	**0.345**
Largemouth Bass	277	10.9	315	0.7	**0.397**
Largemouth Bass	278	10.9	250	0.6	**0.356**
Largemouth Bass	285	11.2	320	0.7	**0.568**
Largemouth Bass	294	11.6	350	0.8	**0.496**
Largemouth Bass	313	12.3	400	0.9	**0.482**
Largemouth Bass	338	13.3	465	1.0	**0.796**

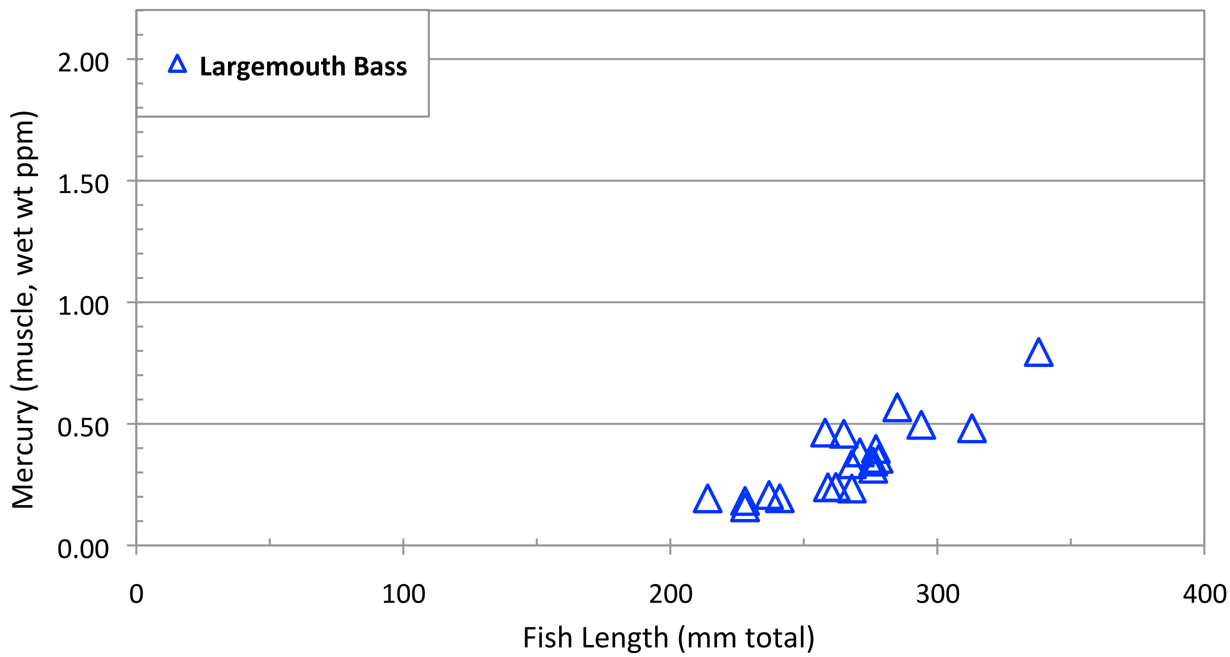

Figure 1. Cemex – Phase 1 Pond: Large fish sampled, 2020
(fillet muscle mercury in individual fish)

Table 2. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Cemex – Phase 1	**2015**	**18**	305	393	**0.278**	± 0.055
Cemex – Phase 1	**2016**	**20**	313	383	**0.350**	± 0.066
Cemex – Phase 1	**2017**	**17**	299	357	**0.393**	± 0.079
Cemex – Phase 1	**2018**	**20**	298	331	**0.481**	± 0.131
Cemex – Phase 1	**2019**	**20**	280	247	**0.404**	± 0.085
Cemex – Phase 1	**2020**	20	267	253	**0.352**	± 0.075
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

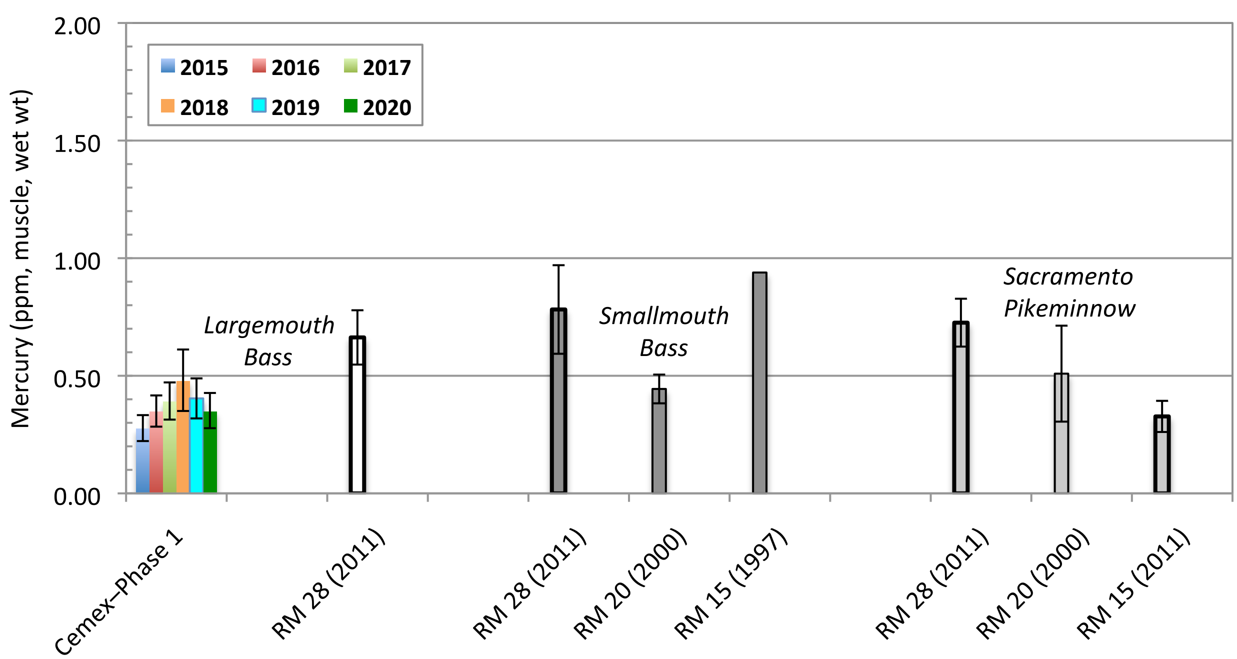

Figure 2. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 3. Channel and White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Channel Catfish						
Cemex – Phase 1	**2015**	2	595	2,130	**0.198**	
Cemex – Phase 1	**2016**	2	412	1,150	**0.100**	
Cemex – Phase 1	**2017**	2	531	1,440	**0.236**	
Cemex – Phase 1	**2018**	3	533	1,973	**0.337**	± 0.587
Cemex – Phase 1	**2019**	*(no catfish of either species were found in 2019 or 2020)*				
White Catfish						
Cemex – Phase 1	**2016**	3	661	2,900	**0.372**	
Cemex – Phase 1	**2017**	**6**	615	2,120	**0.448**	± 0.134
Cemex – Phase 1	**2018**	1	398	1,115	**0.571**	
Historic/Baseline Data						
Channel Catfish						
Rumsey	2000	1	411	565	0.225	
River Mile 28	**2011**	**5**	**239**	**102**	**0.229**	**± 0.102**
River Mile 20	2000	1	368	380	0.225	

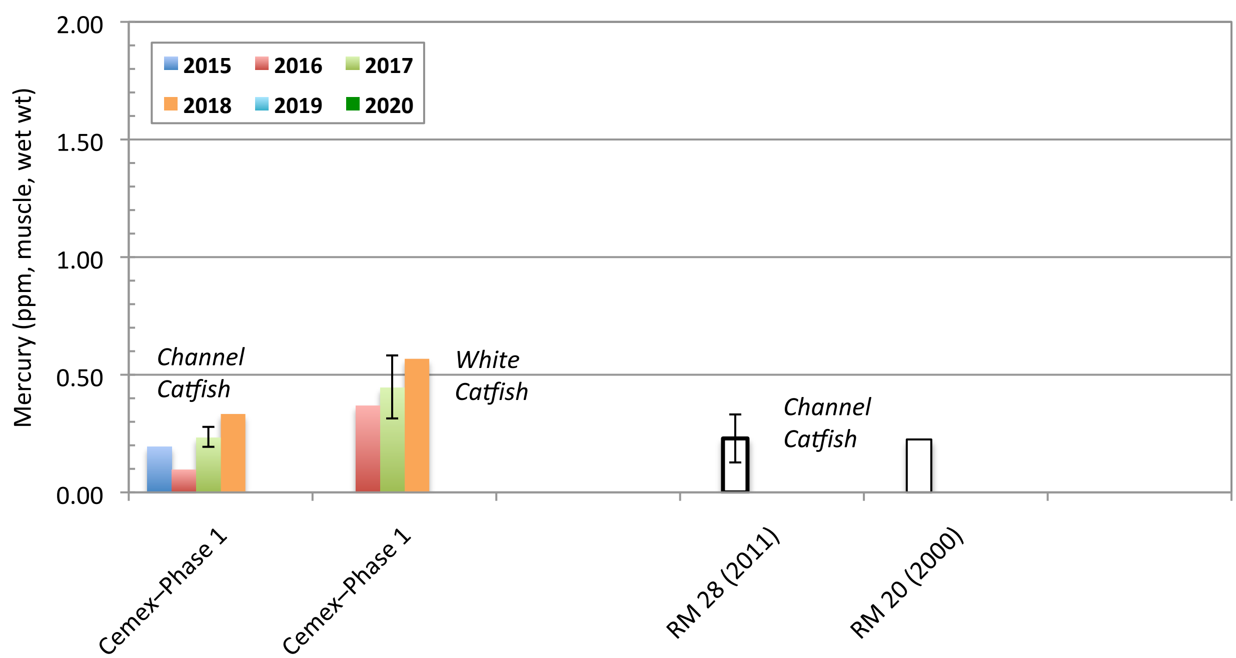

Figure 3. Channel and White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 4. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish						
Cemex – Phase 1	**2016**	**–**				
Cemex – Phase 1	**2017**	**5**	105	35	**0.273**	± 0.094
Cemex – Phase 1	**2018**	1	200	165	**0.227**	
Cemex – Phase 1	**2019**	*(Green Sunfish have not been available here since 2018)*				
Historic/Baseline Data						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

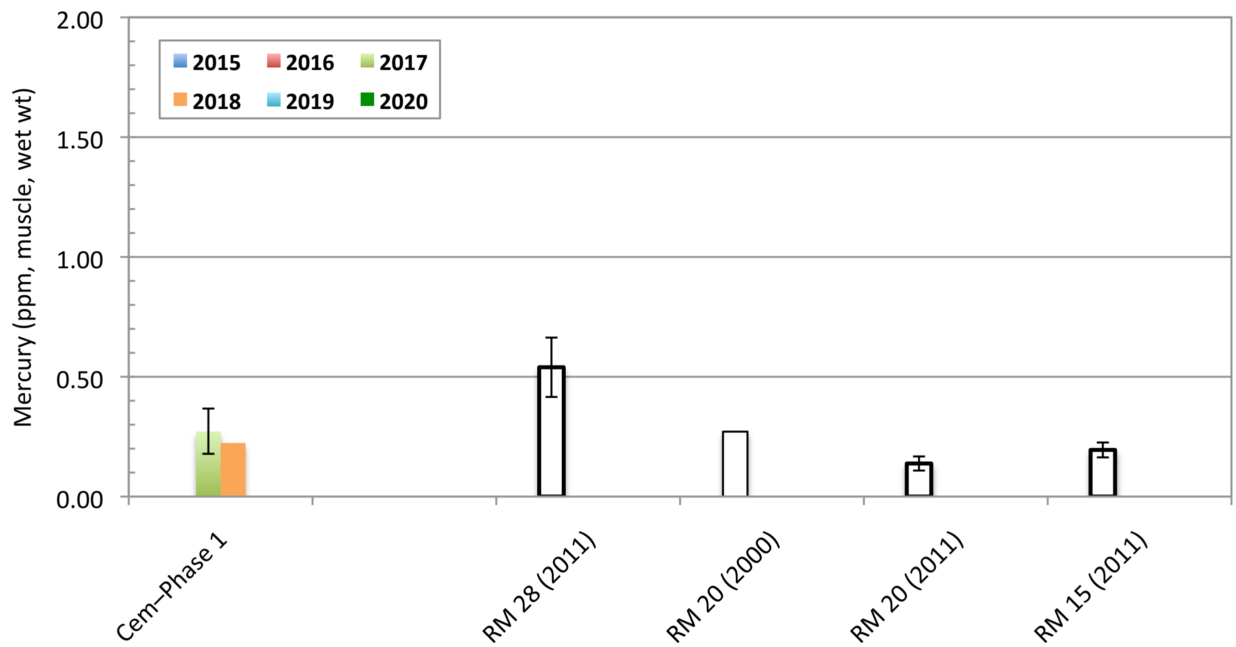

Figure 4. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples (note lower concentration scales)

Table 5. Cemex – Phase 1 Pond: Small Fish Sampled, 2020
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	**n** (indivs. in comp)	Av. Fish Length (mm)	Av. Fish Length (inches)	Av. Fish Weight (g)	Av. Fish Weight (oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	4	84	3.3	7.6	0.27	**0.100**
Largemouth Bass (juv)	4	93	3.7	10.8	0.38	**0.086**
Largemouth Bass (juv)	4	98	3.9	11.5	0.41	**0.103**
Largemouth Bass (juv)	3	106	4.2	14.4	0.51	**0.125**
Largemouth Bass (juv)	2	118	4.6	22.0	0.77	**0.126**
Green Sunfish (juv)	3	35	1.4	0.67	0.024	**0.070**
Green Sunfish (juv)	3	46	1.8	1.72	0.061	**0.088**
Green Sunfish (juv)	1	70	2.8	5.68	0.200	**0.108**
Mosquitofish	12	28	1.1	0.20	0.007	**0.056**
Mosquitofish	12	33	1.3	0.38	0.013	**0.081**
Mosquitofish	12	38	1.5	0.61	0.022	**0.120**
Mosquitofish	12	43	1.7	0.91	0.032	**0.153**

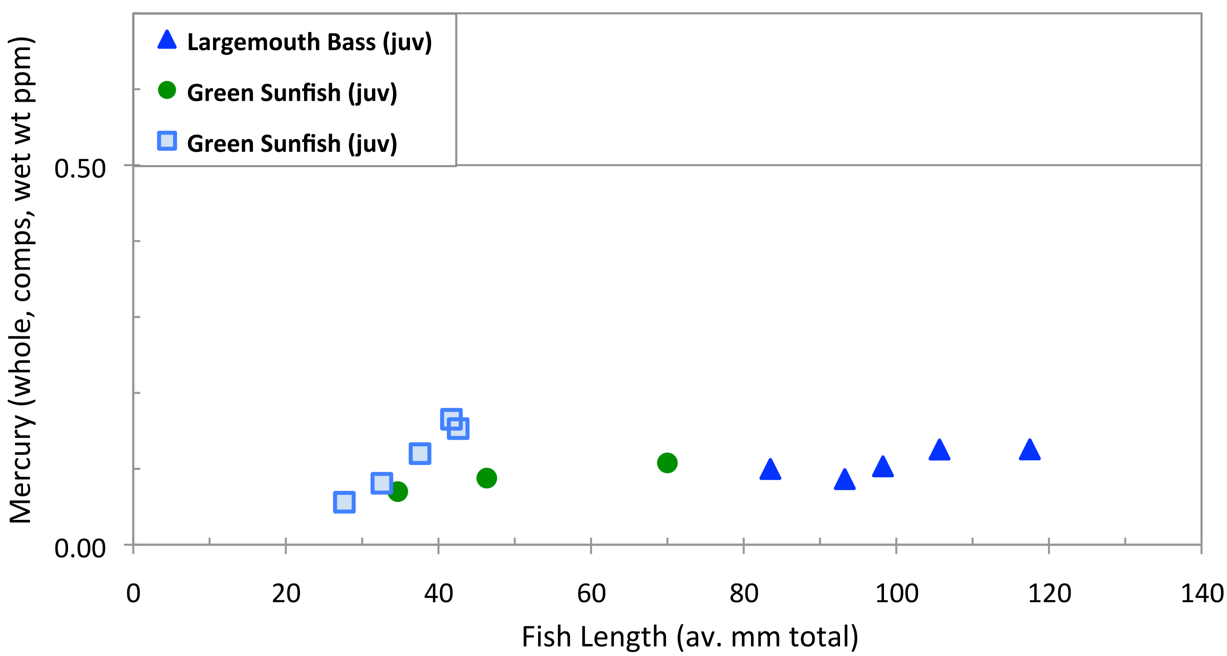

Figure 5. Cemex – Phase 1 Pond: Small, young fish sampled, 2020
(mercury in whole-body, multi-individual composite samples)

Table 6. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Cemex – Phase 1	**2015**	**4**	8	109	17	**0.044**	± 0.004
Cemex – Phase 1	**2016**	**4**	3	102	17	**0.094**	± 0.006
Cemex – Phase 1	**2017**	**4**	2	117	22	**0.146**	± 0.011
Cemex – Phase 1	**2018**	**1**	1	78	6	**0.068**	
Cemex – Phase 1	**2019**	**4**	4-5	106	17	**0.114**	± 0.007
Cemex – Phase 1	**2020**	**5**	2-4	100	13	**0.104**	± 0.008
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

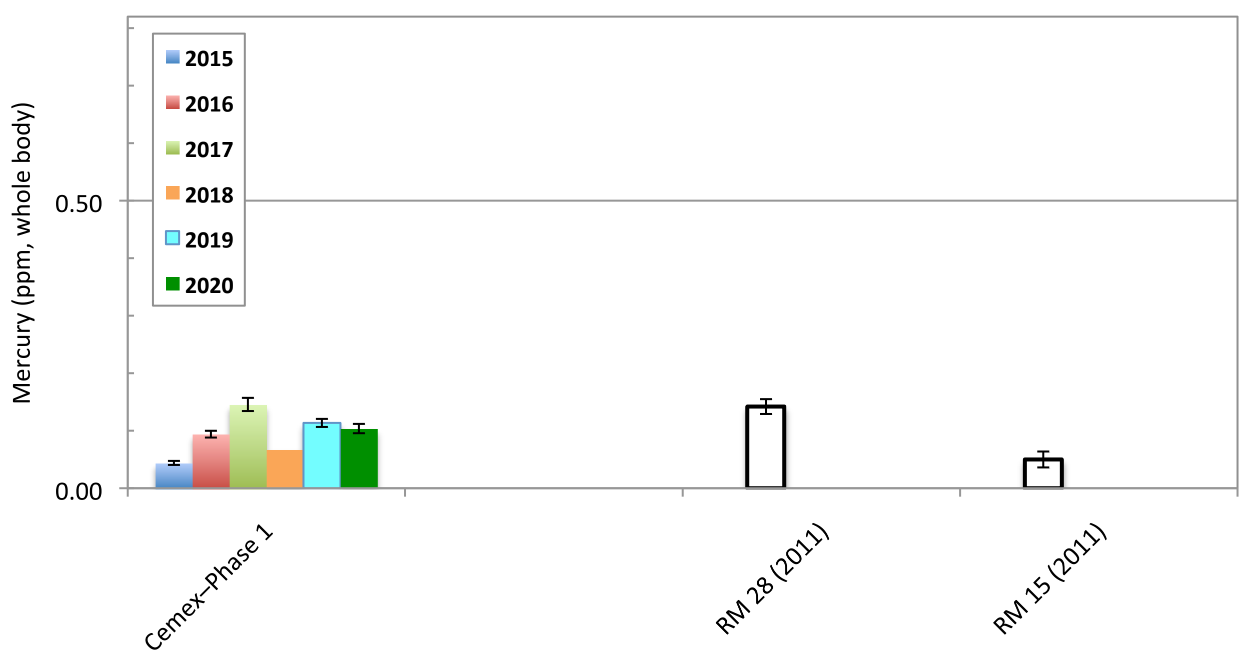

Figure 6. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 7. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Cemex – Phase 1	**2015**	**4**	10	39	0.6	**0.075**	± 0.008
Cemex – Phase 1	**2016**	**4**	10	34	0.4	**0.093**	± 0.019
Cemex – Phase 1	**2017**	**4**	10	33	0.4	**0.135**	± 0.019
Cemex – Phase 1	**2018**	**4**	6-10	34	0.5	**0.083**	± 0.016
Cemex – Phase 1	**2019**	**4**	10	34	0.5	**0.096**	± 0.024
Cemex – Phase 1	**2020**	**4**	12	35	0.5	**0.102**	± 0.021
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

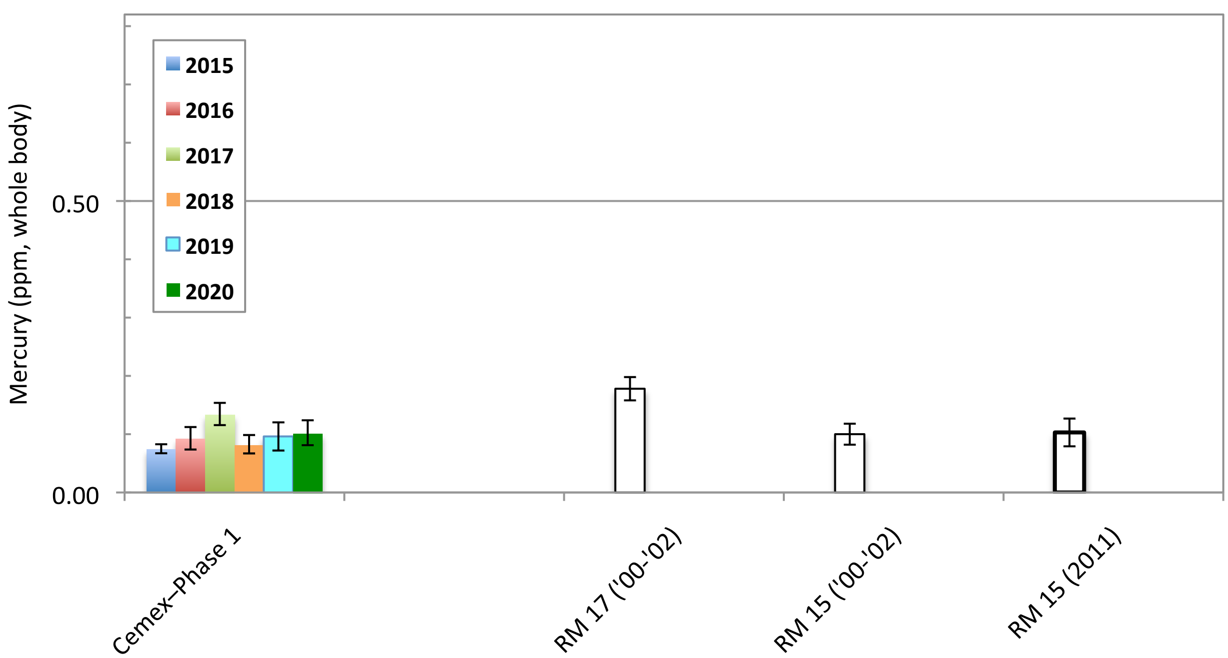

Figure 7. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 8. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Cemex – Phase 1	**2017**	**4**	8-10	47	1.9	**0.118**	± 0.023
Cemex – Phase 1	**2018**	**4**	2	51	2.1	**0.035**	± 0.009
Cemex – Phase 1	**2019**	**4**	2-10	44	1.7	**0.089**	± 0.011
Cemex – Phase 1	**2020**	**3**	1-3	50	2.7	**0.089**	± 0.009
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

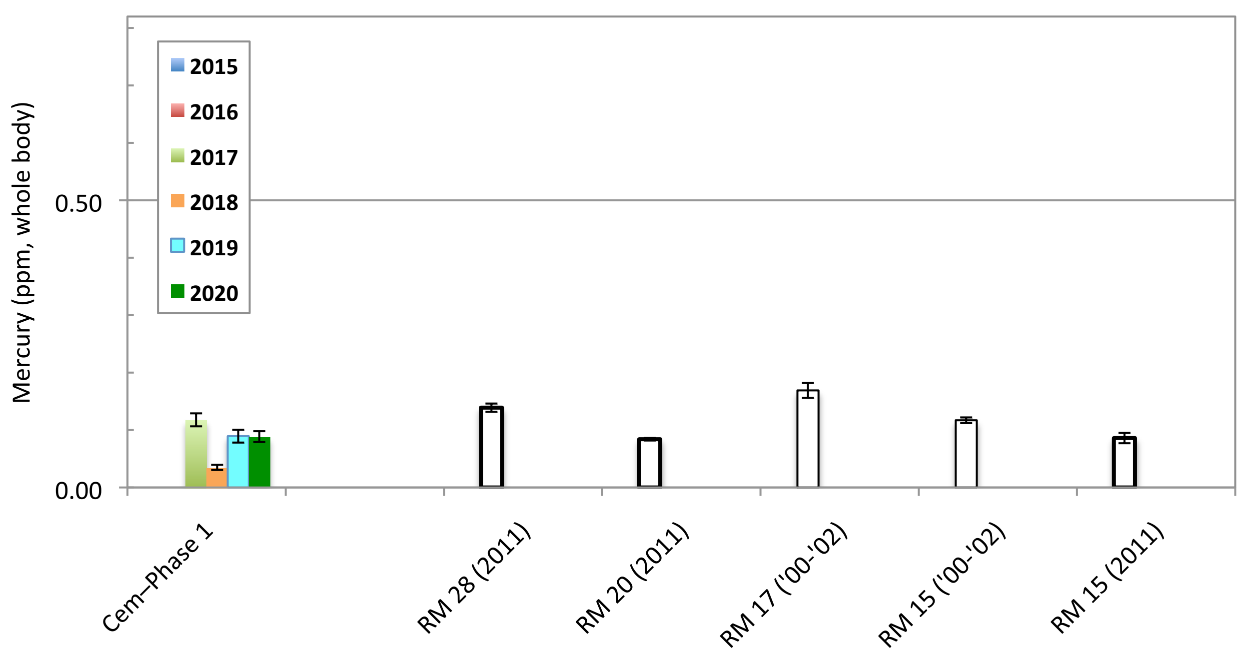

Figure 8. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

2. CEMEX–PHASE 3-4 POND

(Google Earth 10/21/2020)

2. CEMEX – PHASE 3-4 POND *(Tables and Figures 9-15)*

Summary

Twenty adult Largemouth Bass were sampled, and multiple composite samples were taken of young-of-year Mosquitofish, juvenile Green Sunfish, and juvenile Largemouth Bass. Mercury levels were down from the year before (2019), which in turn had come down from the peak levels found here before 2019. Overall fish mercury at this pond in 2020 was, for the first time, not elevated over comparable creek baseline samples, for all sample types with enough numbers to compare. However, because it was earlier found to be "elevated for three or more years of five" over creek baselines (2015-2019, all 5 years), that triggered the addition of "expanded analysis" and, following a period of data gathering, development of a mercury management plan. Expanded analysis work began here in 2018, with seasonal water column profiling of a range of relevant constituents and testing of bottom sediments, and is presented in accompanying reports.

Summary 2020 Cemex – Phase 3-4 Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	≤	INC	Largemouth Bass
		≤	Mosquitofish
		≤	Sunfish
Overall 2020 Findings	≤		

This pond is the more recent (approx. 2002), and actively mined, of the two Cemex ponds. It is also located just south of Cache Creek and east of Highway 505. Phase 3-4 is to the east of the Phase 1 Pond. The Phase 3-4 Pond is a large, elongated water body that is approximately 1,200 m long (1.2 km) and 400 m wide. Maximum depth ranged narrowly between 9.9 and 10.7 m (33-35 feet) in 2020. This pond continued to be actively mined in 2020. Mining was confined to the larger, eastern (Phase 4) sub-basin. This (2020) was Year 6 of monitoring.

We sampled the pond during day and twilight conditions with a range of techniques, and collected useful samples of most of the fish species present. These included individual fillet muscle samples of 20 Largemouth Bass (*Micropterus salmoides*) across the range of sizes present. The small fish available were juvenile Green Sunfish (*Lepomis cyanellus*, 1-2"), and Mosquitofish (*Gambusia affinis*, 1-2"), each sampled with 4 multi-individual composites. Juvenile bass were extremely scarce and are represented by a single sample. Predation pressure at this site is very high.

In total, 20 large fish muscle samples and 9 small fish composite samples, 29 separate mercury samples, were analyzed from the Cemex–Phase 3-4 Pond in the Fall 2020 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 9 and, graphically, in Figure 9. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2019 results and the most closely comparable historic creek data (Tables and Figures 10-11). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 12-15.

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Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 9 and 10)

The 2020 samples ranged between 217 and 351 mm (about 9-14"). They had fillet muscle mercury ranging from 0.379-0.959 ppm, averaging 0.656 ppm. This was down from 2019 (0.819 ppm), 2018 (0.918 ppm) and 2017 (1.093 ppm); the difference was statistically significant versus 2017 and 2018 levels. The 2020 average was in fact the lowest found yet at this site. Similar to last year, the larger individuals over about 310 mm (12") had the highest mercury levels, averaging 0.755 ppm and increasing generally with size (Figure 9). This was significantly lower than last year's fish in the same size range (2019: 1.111 ppm). Also like last year, the set of smaller sizes under about 12" had a nearly flat, lower mercury trend, averaging 0.472 ppm. The probable causes for this split have been discussed in previous reports; they include 1) a shift in diet to higher mercury food at larger size (often a shift from aquatic invertebrates to fish), or/and 2) a recent drop in mercury exposure levels, which would show up more quickly in the smaller/younger fish (due to recent months being a larger proportion of their lifetime mercury accumulation). Adult bass represent the top predator fish in this region and will typically have the highest mercury levels at any given site, with the highest levels in the largest, oldest fish. In relation to comparable baseline Cache Creek samples, the 2020 Phase 3-4 bass were, for the first time, not elevated on average; the 2020 average bass mercury level was lower than 4 of 7 historical comparisons (not statistically significant) and higher than 3 of 7 (statistically significant for 2). Even the larger fish over 12" (averaging 0.755 ppm) were lower than or statistically similar to 5 of 7 creek comparisons.

Green Sunfish (Tables/Figures 9 and 11)
We have not been able to collect adults of this species in useful numbers here since 2015. Earlier data are shown.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 12 and 13)
As last year, we were able to obtain just one juvenile bass in 2020, with extensive seining. There is tremendous predation pressure on them here from the thriving adult bass population. The single 124 mm (5") individual had whole body mercury at 0.144 ppm. This was substantially lower than last year's single individual (0.336 ppm), as well as the fish from this pond in 2015-2017 (0.249-0.372 ppm) when we were able to get more extensive samples. All of the juvenile bass data from this site before 2020 have been far above the baseline creek comparisons (0.050-0.142 ppm). The 2020 single individual, at 0.144 ppm, was similar to one of the two baseline sample means but, with just one sample, cannot be assessed statistically.

Juvenile Green Sunfish (Tables/Figures 12 and 14)
Like the juvenile bass, young sunfish were scarce, but we were able to collect two sets of 12-each in the 30-40 mm range, plus several larger size class individuals (41-47 mm) split into two additional composites. The samples had whole-body mercury ranging from 0.074-0.184 ppm and averaging 0.117 ppm. This was statistically similar to the lowest readings found at this site (2018:

0.112 ppm), and was significantly lower than in 2015 (0.275 ppm), 2016 (0.233 ppm), and 2019 (0.185 ppm). Compared to baseline juvenile Green Sunfish mercury from Cache Creek, Phase 3-4 Pond fish in 2020 were not elevated; they were broadly similar to the five available creek comparisons – statistically lower than one, statistically similar to three, and statistically higher than one.

Mosquitofish (Tables/Figures 12 and 15)

Three size-class composites of 12-fish-each were taken, plus three larger individuals forming a fourth composite. The 2020 samples had whole-body mercury ranging from 0.084-0.164 ppm, averaging 0.112 ppm. This was significantly lower than last year (2019: 0.183 ppm) and, in fact, was significantly lower than in all previous years here (0.157-0.286 ppm). Relative to the baseline Cache Creek comparison samples, the 2020 Cemex–Phase 3-4 Mosquitofish were, for the first time, not elevated; they were statistically similar in mercury to the two sets from River Mile 15 (0.100-0.103 ppm) and significantly lower than the River Mile 17 sample sets (0.178 ppm).

Table 9. Cemex – Phase 3-4 Pond: Individual large fish sampled, 2020

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	217	8.5	125	0.3	**0.393**
Largemouth Bass	231	9.1	145	0.3	**0.379**
Largemouth Bass	270	10.6	265	0.6	**0.416**
Largemouth Bass	288	11.3	295	0.7	**0.416**
Largemouth Bass	301	11.9	360	0.8	**0.462**
Largemouth Bass	302	11.9	375	0.8	**0.462**
Largemouth Bass	305	12.0	345	0.8	**0.440**
Largemouth Bass	310	12.2	360	0.8	**0.641**
Largemouth Bass	312	12.3	370	0.8	**0.597**
Largemouth Bass	316	12.4	385	0.8	**0.740**
Largemouth Bass	318	12.5	445	1.0	**0.828**
Largemouth Bass	320	12.6	450	1.0	**0.810**
Largemouth Bass	322	12.7	425	0.9	**0.680**
Largemouth Bass	328	12.9	450	1.0	**0.959**
Largemouth Bass	336	13.2	515	1.1	**0.638**
Largemouth Bass	339	13.3	525	1.2	**0.925**
Largemouth Bass	342	13.5	545	1.2	**0.863**
Largemouth Bass	343	13.5	515	1.1	**0.736**
Largemouth Bass	347	13.7	565	1.2	**0.780**
Largemouth Bass	351	13.8	510	1.1	**0.949**

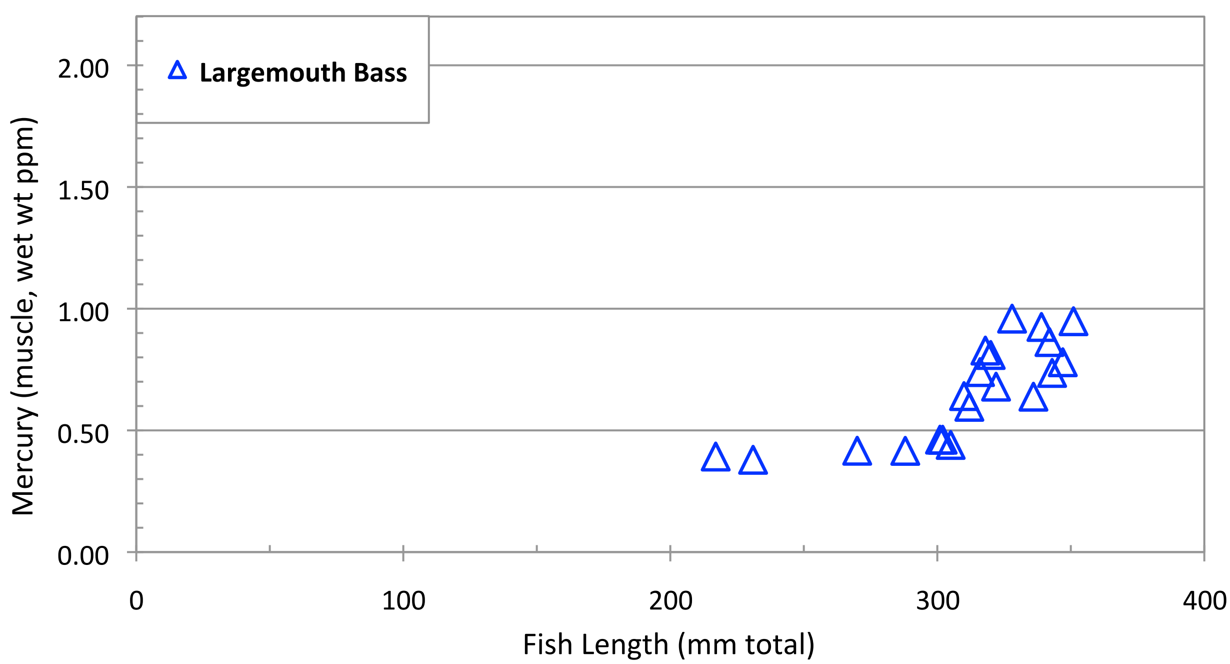

Figure 9. Cemex – Phase 3-4 Pond: Large fish sampled, 2020
(fillet muscle mercury in individual fish)

Table 10. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Cemex – Phase 3-4	**2015**	**20**	344	526	**0.840**	± 0.113
Cemex – Phase 3-4	**2016**	**20**	344	557	**0.858**	± 0.139
Cemex – Phase 3-4	**2017**	**20**	334	479	**1.093**	± 0.172
Cemex – Phase 3-4	**2018**	20	331	463	**0.918**	± 0.119
Cemex – Phase 3-4	**2019**	**20**	312	402	**0.819**	± 0.195
Cemex – Phase 3-4	**2020**	20	310	399	**0.656**	± 0.094
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

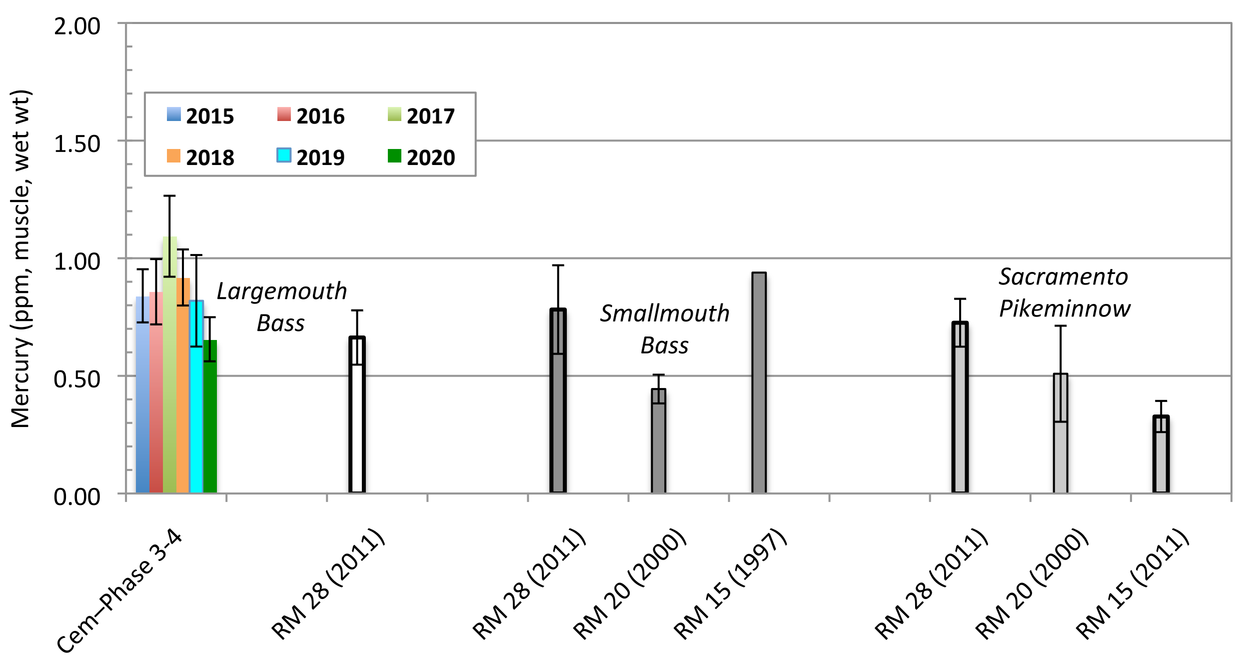

Figure 10. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 11. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish						
Cemex – Phase 3-4	**2015**	**10**	133	67	**0.534**	± 0.076
Cemex – Phase 3-4	**2016**	**1**	101	16	**0.382**	
Cemex – Phase 3-4	**2017**	**–**				
Cemex – Phase 3-4	**2018**	**–**				
Cemex – Phase 3-4	**2019**	*(Green Sunfish have not been available here since 2016)*				
Historic/Baseline Data						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

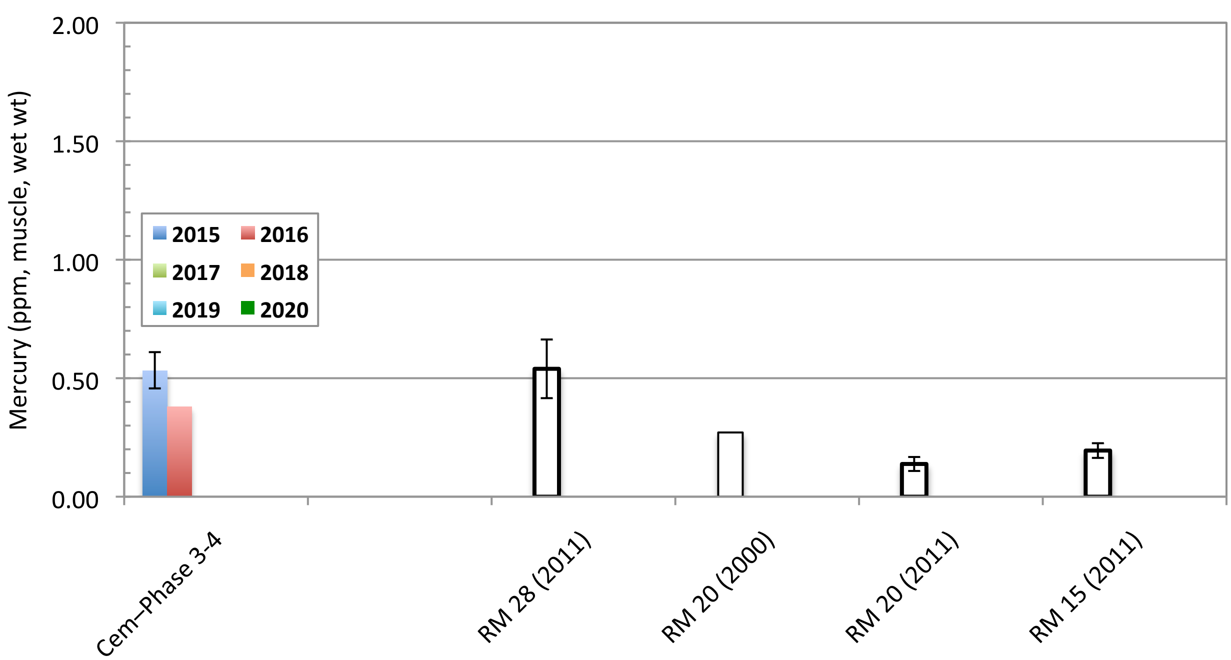

Figure 11. Green Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 12. Cemex – Phase 3-4 Pond: Small Fish Sampled, 2020
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	1	124	4.9	23.0	0.81	**0.144**
Green Sunfish (juv)	12	30	1.2	0.40	0.014	**0.074**
Green Sunfish (juv)	12	35	1.4	0.58	0.020	**0.096**
Green Sunfish (juv)	2	41	1.6	1.04	0.037	**0.112**
Green Sunfish (juv)	1	47	1.9	1.61	0.057	**0.184**
Mosquitofish	12	27	1.1	0.18	0.006	**0.084**
Mosquitofish	12	30	1.2	0.23	0.008	**0.087**
Mosquitofish	12	34	1.3	0.36	0.013	**0.115**
Mosquitofish	3	41	1.6	0.76	0.027	**0.164**

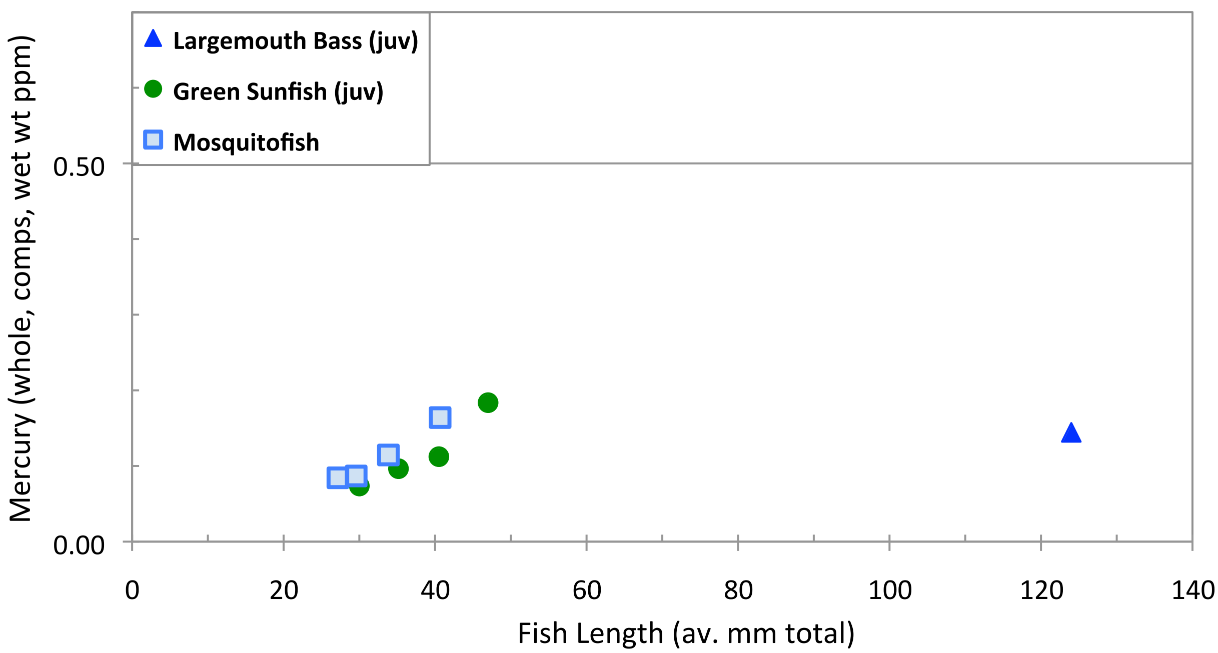

Figure 12. Cemex – Phase 3-4 Pond: Small, young fish sampled, 2020
(mercury in whole-body, multi-individual composite samples)

Table 13. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Cemex – Phase 3-4	**2015**	**4**	7	108	16	**0.334**	± 0.052
Cemex – Phase 3-4	**2016**	**4**	2	114	18	**0.372**	± 0.053
Cemex – Phase 3-4	**2017**	**4**	2-3	108	16	**0.249**	± 0.033
Cemex – Phase 3-4	**2018**	*(no samples)*					
Cemex – Phase 3-4	**2019**	**1**	1	125	23	**0.336**	
Cemex – Phase 3-4	**2020**	**1**	1	124	23	**0.144**	
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

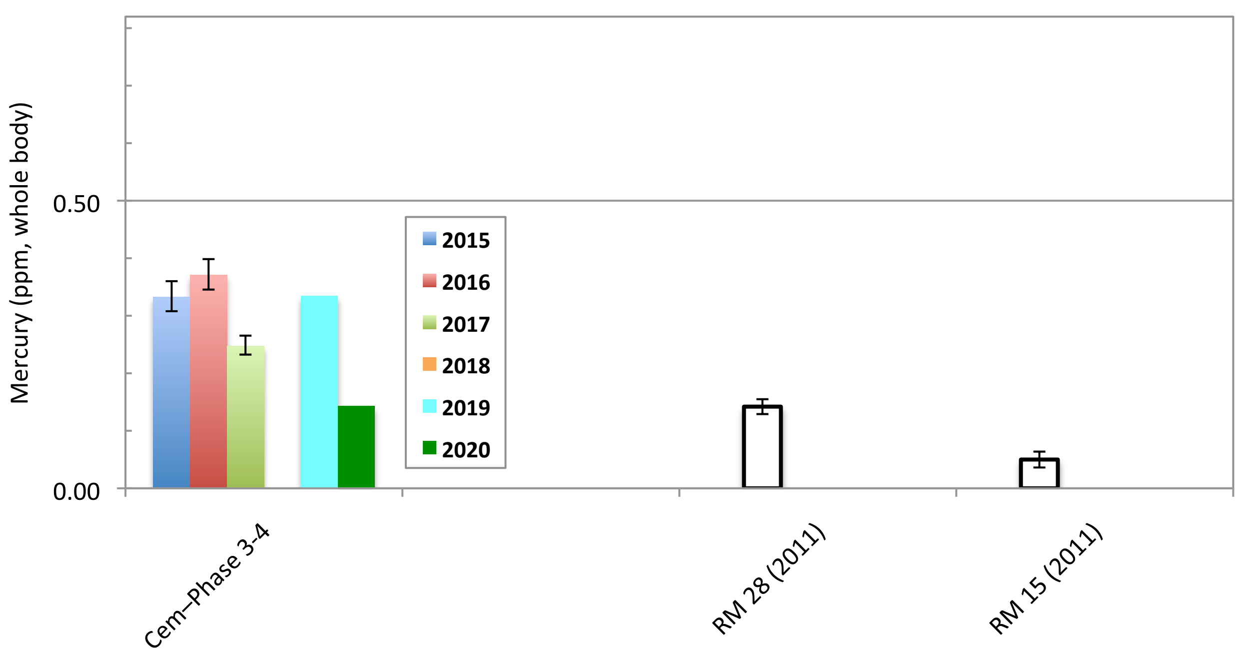

Figure 13. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 14. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Cemex – Phase 3-4	**2015**	**4**	10	47	1.8	**0.275**	± 0.022
Cemex – Phase 3-4	**2016**	**4**	4-5	49	2.0	**0.233**	± 0.026
Cemex – Phase 3-4	**2017**	**4**	2-6	36	0.7	**0.150**	± 0.051
Cemex – Phase 3-4	**2018**	**4**	1	34	0.5	0.112	± 0.020
Cemex – Phase 3-4	**2019**	**4**	10	43	1.6	**0.185**	± 0.016
Cemex – Phase 3-4	**2020**	**4**	1-12	38	0.9	**0.117**	± 0.024
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

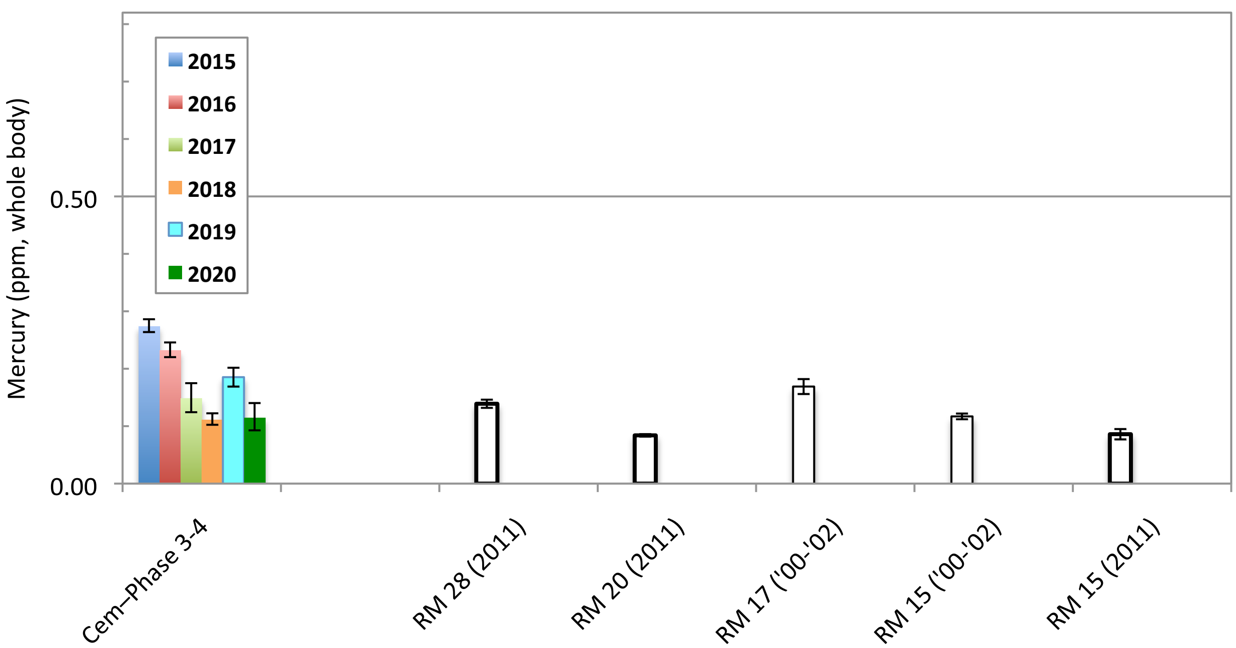

Figure 14. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 15. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Cemex – Phase 3-4	**2015**	**4**	10	37	0.6	**0.228**	± 0.029
Cemex – Phase 3-4	**2016**	**4**	10	37	0.6	**0.157**	± 0.019
Cemex – Phase 3-4	**2017**	**4**	6-10	34	0.5	**0.286**	± 0.035
Cemex – Phase 3-4	**2018**	**4**	3-10	34	0.5	**0.203**	± 0.021
Cemex – Phase 3-4	**2019**	**4**	10	35	0.6	**0.183**	± 0.029
Cemex – Phase 3-4	**2020**	**4**	3-12	33	0.4	**0.112**	± 0.018
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

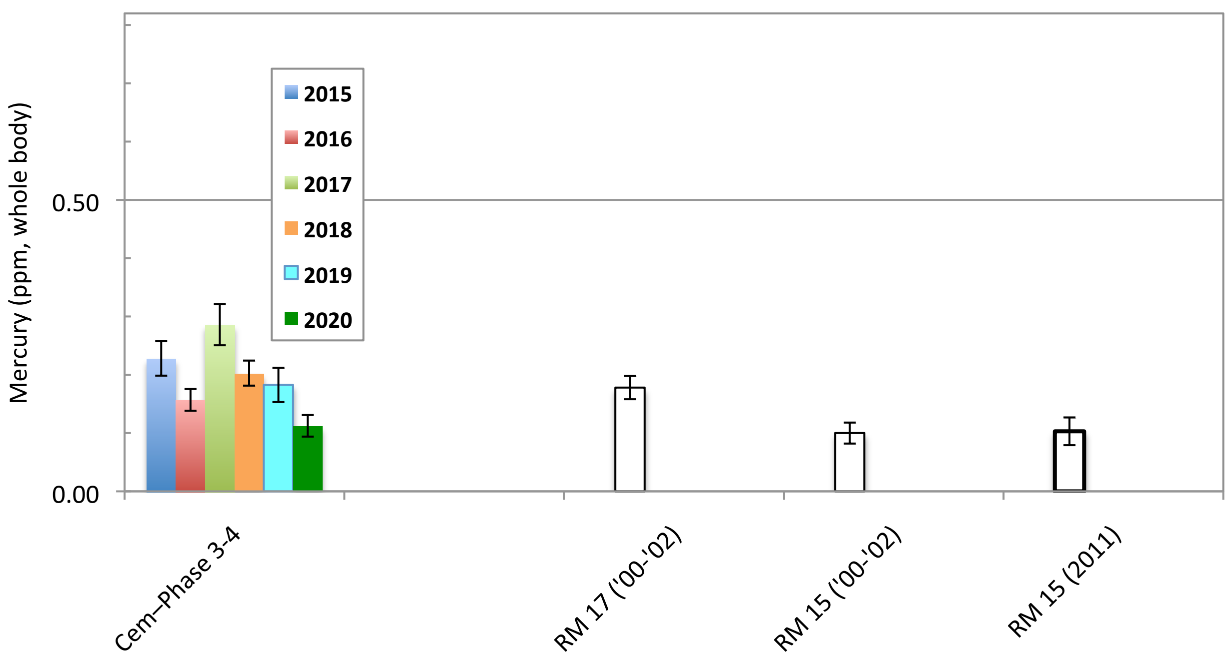

Figure 15. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

3. TEICHERT – ESPARTO POND

(Google Earth 10/21/2020)

3. TEICHERT – ESPARTO POND *(Tables and Figures 16-24)*

Summary

Before the 2020 sampling season, the previously separate Reiff and Mast Ponds were combined by Teichert into a single large Esparto Pond, by excavating parts of dividing levees. Monitoring continued in the combined pond in 2020. As in prior years in Reiff Pond, several large fish species were present; samples were taken of adult Largemouth Bass (13), White Catfish (10), and Common Carp (7). Small, young-of-year fish were also collected, with multiple composite samples of Mosquitofish, juvenile Largemouth Bass, and juvenile Green Sunfish. The adult fish samples averaged a decline in mercury levels from last year, continuing a recent trend. The small, young fish (more representative of recent conditions) showed a reversing trend though, with higher levels in 2020. Despite the relative ups and downs, this site remained highly elevated in mercury in 2020. <u>All of the fish sample types averaged significantly higher mercury than corresponding Cache Creek baseline samples; the Teichert-Esparto Pond remained in the "elevated over baseline" category in 2020. Similar results from previous years in the Reiff and Mast ponds triggered the collection of additional information ("expanded analysis") to help guide development of a mercury management plan</u>. Water column profiling and collection of bottom sediment samples began in May 2018 and are the subject of accompanying reports.

Summary 2020 Teichert–Esparto Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	>	>	Largemouth Bass
White Catfish	>	>	Mosquitofish
Carp	>	>	Sunfish
Overall 2020 Findings	>		

Before the 2020 sampling season, the previously separate Reiff and Mast Ponds were combined by Teichert into a single large Esparto Pond, by excavating parts of dividing levees. Monitoring continued in the combined pond in 2020. The site is located at Teichert's Esparto Facility, just north of Cache Creek and west of Highway 505, between 505 and County Road 87. Mining began here in or before 2002. Active mining has been sporadic over the years, but aggregate processing was mostly continuous; slurry returns have typically kept the pond water very turbid/opaque. The combined Esparto Pond is approximately 1100 m long (1.1 km) and 300-500 m wide. Maximum depths in 2020 ranged from 10.4-11.3 m (34-37 ft). Continuing from previous testing in Reiff and Mast Ponds, this (2020) was Year 6 of monitoring.

We sampled the pond during day, twilight, and night conditions with a wide range of gear. The fish collected included, for large, angling-sized fish, samples of 13 Largemouth Bass (*Micropterus salmoides*), 10 White Catfish (*Ameiurus catus*), and 7 Common Carp (*Cyprinus carpio*). Small, young-of-year fish samples included juvenile Largemouth Bass (3-4"), juvenile Green Sunfish (*Lepomis cyanellus*, 1-2"), and Mosquitofish (*Gambusia affinis*, 1-2"). We collected 4 multi-individual composite samples from each of these 3 species. Red Shiners (*Cyprinella lutrensis*), present from 2015-2018, could not be found in 2019 or 2020.

In total, this added up to 30 large fish muscle samples and 12 young, small fish composites, or 42 separate mercury samples analyzed from the Esparto Pond in the Fall 2020 monitoring. The fish metrics and analytical results from each individual large fish muscle sample can be seen in Table 16 and, graphically, in Figure 16. Then, for each large fish species taken, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2019 results and the most closely comparable historic creek data (Tables and Figures 17-19). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 20-24.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 16 and 17)

We took a sample of 13 bass in 2020, leaving sample numbers for the other large species present in this pond, catfish and carp (≤ 30 total large fish samples per monitored pond). The bass present in 2020 ranged in size mostly from 242-358 mm (9-14") and 150-630 g (0.3-1.4 lbs), with a single much larger fish of 465 mm (18.3") and 1610 g (3.5 lbs). Mercury concentrations increased with size, as is normal, particularly in the fish over about 310 mm (12"). The very large individual had the highest concentration (2.014 ppm). The average mercury, across the full size range, was 1.238 ppm, very similar to last year (2019: 1.183 ppm) and significantly lower than peak levels found in 2018 (1.997 ppm) and 2017 (1.679 ppm). These are all very high fish mercury levels though. Despite being relatively lower than peak levels for this pond, the 2020 average was again the highest among the currently monitored ponds. In relation to comparable baseline Cache Creek data, the Esparto Pond 2020 adult Largemouth Bass were elevated in mercury; significantly above all Cache Creek comparisons.

White Catfish (Tables/Figures 16 and 18)

Ten adult White Catfish were taken in 2020, in the size range of 325-402 mm (13-16") and 500-955 g (1.1-2.1 lbs). Muscle mercury ranged between 0.242 and 0.726 ppm, averaging 0.408 ppm. This was down from last year (2019: 0.637 ppm) and significantly below all previous catfish averages in the record (0.737-1.287 ppm) from the Reiff Pond when it was separated from the Mast basins. This was in spite of the 2020 catfish samples averaging somewhat larger in size than all the previous sets. However, relative to Cache Creek comparison data, the Esparto Pond 2020 White Catfish mercury levels remained elevated.

Carp (Tables/Figures 16 and 19)

Seven adult Carp were taken in 2020, including a set of four fish in a much smaller/younger size range than found in previous years here: 209-332 mm (8-13") and 140-465 g (0.3-1.0 lbs). The remaining three fish were much larger: 482-565 mm (19-22") and 1550-2650 g (3.4-5.8 lbs). Not surprisingly, the two groups had divergent mercury levels: muscle mercury in the small carp ranged narrowly between 0.288 and 0.388 ppm, averaging 0.354 ppm. The larger fish had much higher levels of 0.863-1.106 ppm, averaging 1.012 ppm. The overall average for 2020 was 0.636 ppm. In comparison with baseline Cache Creek samples, the Esparto Pond 2020 carp were elevated in mercury; even the small/young set was higher than all comparison data, significantly above the 4 of 5 that can be assessed statistically. As in other years, the largest carp had similar levels to some of the 2020 bass. In previous reports, we have pointed out that this is odd, as carp typically feed lower on the food chain (on lower-mercury food items) than the top-predator bass and would be expected to accumulate less mercury. We pointed out that this could be due to age differences, with the carp likely being much older than the recently colonizing bass, giving the old carp time to slowly accumulate higher mercury than would be found in carp the same age as the bass. With the new data from small/young carp this year, it is clear that this is likely the case: carp of a similar age as the co-occurring bass had much lower mercury than the bass; the large carp with high mercury were certainly much older fish.

Green Sunfish

Adult Green Sunfish have not available in statistically useful numbers here, in all the monitoring years. None were taken in 2020.

Small, Young Fish

Mosquitofish (Tables/Figures 20 and 21)

Mosquitofish have been difficult to collect in some years, but we were able to obtain composite samples of 12-fish-each from the two smaller size classes in 2020, plus 3 larger individuals which were analyzed in two more samples of 2 and 1 fish each. The size classes broadly matched the standard sizes monitored through the years at this and the other sites. Mercury in the four composite sets ranged from 0.185-0.328 ppm, increasing sharply in the larger size classes and averaging 0.267 ppm. This was statistically similar to 2018-2019 levels (0.222-0.262 ppm) and significantly above the 2016 average (0.212 ppm) and, especially, 2015 levels (0.094 ppm). The 2020 Esparto Pond Mosquitofish mercury concentrations remained significantly elevated over corresponding Cache Creek baseline samples (0.094-0.172 ppm).

Red Shiner (Table/Figure 22)

As last year, Red Shiners were not found in sufficient numbers for sampling in 2020. We suspect the growing population of Largemouth Bass has preferentially consumed them out of existence. Data from prior years are presented for completeness.

Juvenile Largemouth Bass (Tables/Figures 20 and 23)

In contrast with the Red Shiners, juvenile Bass were present in ample enough numbers for four composite samples of three individuals each. These samples had whole-body mercury ranging from 0.400-0.517 ppm, averaging 0.472 ppm. This was significantly higher than the 2019 samples (0.297 ppm), statistically similar to the 2018 samples (0.445 ppm) and significantly, much lower than the 2017 levels (0.798 ppm), all in similar, young-of-year fish. Relative to baseline juvenile bass comparison data from Cache Creek, despite the large decreases since 2017, the 2020 Esparto Pond juvenile Largemouth Bass remained elevated; far above and significantly higher in mercury than the two creek sample sets available: River Mile 28 (0.142 ppm) and River Mile 15 (0.050 ppm).

Juvenile Green Sunfish (Tables/Figures 20 and 24)

Four composite samples of three individuals each were collected. These samples had whole-body mercury at 0.206-0.285 ppm, averaging 0.230 ppm. This was statistically similar to previous data from this site (0.187-0.252 ppm). As compared to Cache Creek baseline comparison samples, the 2020 Reiff juvenile sunfish were significantly higher in mercury than all of the baseline sets.

Table 16. Teichert – Esparto Pond: Individual large fish sampled, 2020

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	242	9.5	150	0.3	**0.985**
Largemouth Bass	258	10.2	195	0.4	**1.085**
Largemouth Bass	261	10.3	230	0.5	**0.954**
Largemouth Bass	264	10.4	200	0.4	**0.931**
Largemouth Bass	276	10.9	240	0.5	**1.024**
Largemouth Bass	295	11.6	310	0.7	**0.962**
Largemouth Bass	300	11.8	335	0.7	**1.056**
Largemouth Bass	312	12.3	415	0.9	**1.059**
Largemouth Bass	332	13.1	525	1.2	**1.551**
Largemouth Bass	332	13.1	465	1.0	**1.367**
Largemouth Bass	349	13.7	585	1.3	**1.591**
Largemouth Bass	358	14.1	630	1.4	**1.516**
Largemouth Bass	465	18.3	1610	3.5	**2.014**
White Catfish	325	12.8	500	1.1	**0.677**
White Catfish	330	13.0	605	1.3	**0.726**
White Catfish	346	13.6	602	1.3	**0.420**
White Catfish	348	13.7	525	1.2	**0.416**
White Catfish	366	14.4	755	1.7	**0.337**
White Catfish	380	15.0	840	1.9	**0.452**
White Catfish	392	15.4	790	1.7	**0.291**
White Catfish	398	15.7	920	2.0	**0.265**
White Catfish	398	15.7	925	2.0	**0.254**
White Catfish	402	15.8	955	2.1	**0.242**
Carp	209	8.2	140	0.3	**0.382**
Carp	217	8.5	155	0.3	**0.288**
Carp	314	12.4	465	1.0	**0.388**
Carp	332	13.1	445	1.0	**0.357**
Carp	482	19.0	1550	3.4	**1.106**
Carp	545	21.5	2200	4.9	**1.066**
Carp	565	22.2	2650	5.8	**0.863**

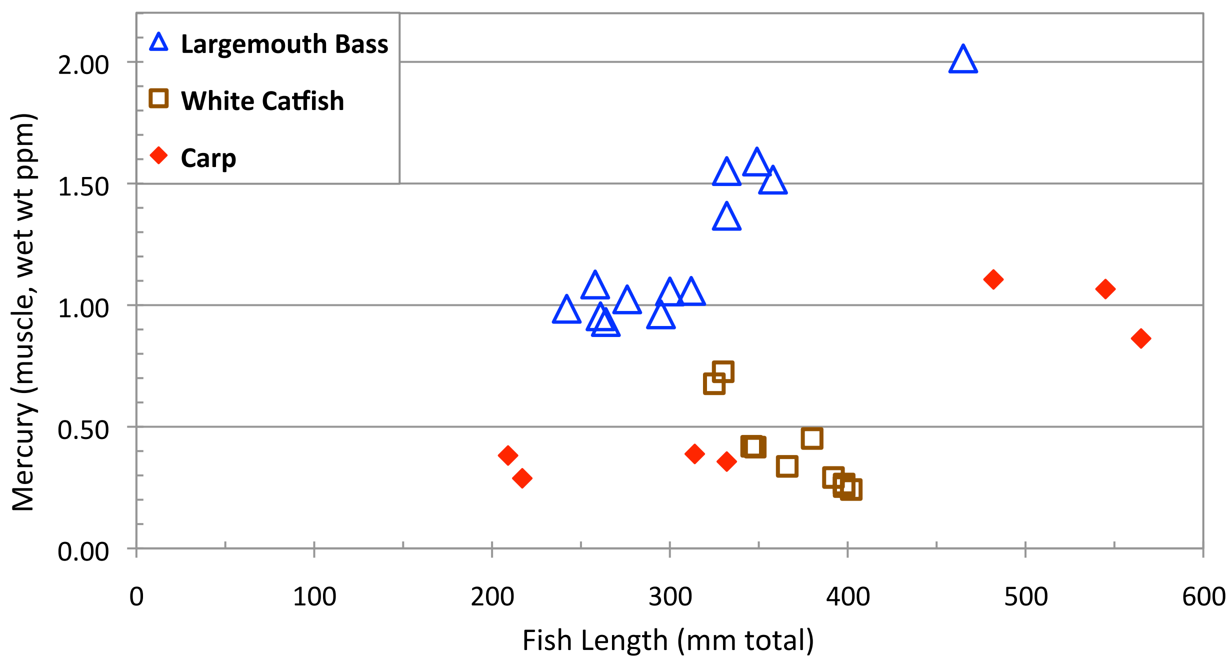

Figure 16. Teichert – Esparto Pond: large fish sampled, 2020
(fillet muscle mercury in individual fish)

Table 17. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Teichert – Reiff	**2017**	**5**	189	78	**1.679**	± 0.180
Teichert – Reiff	**2018**	**10**	251	181	**1.997**	± 0.170
Teichert – Reiff	**2019**	**10**	295	353	**1.183**	± 0.314
Teichert – Esparto	**2020**	**13**	311	453	**1.238**	± 0.204
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

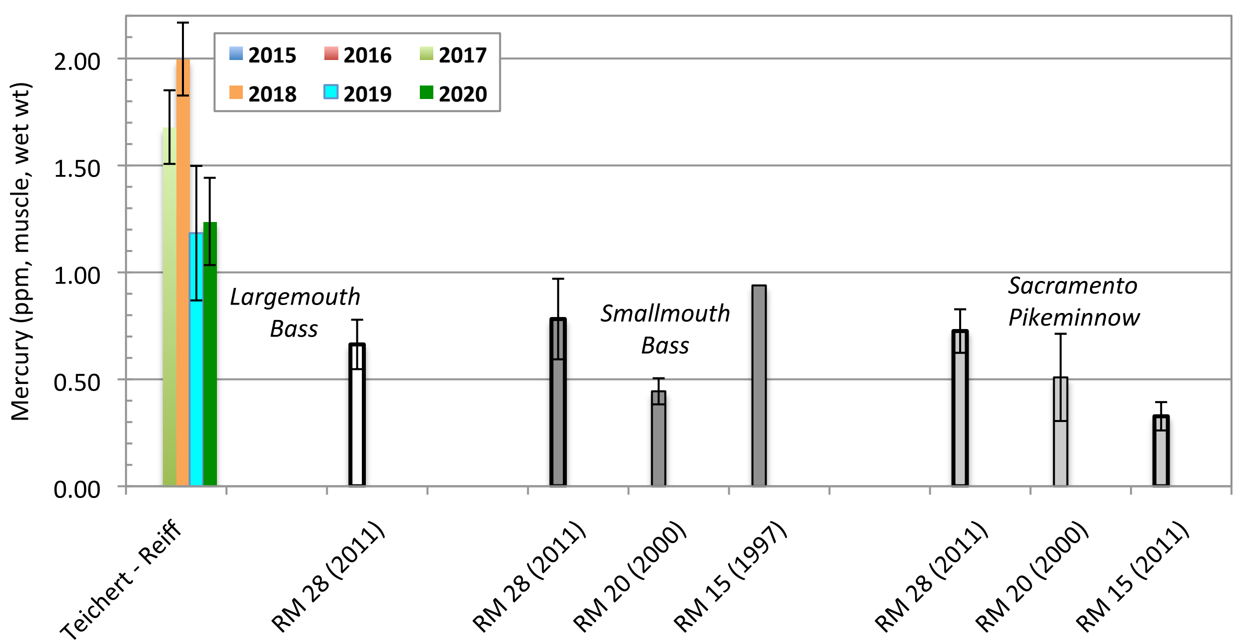

Figure 17. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 18. White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
White Catfish						
Teichert – Reiff	**2015**	**20**	347	658	**0.737**	± 0.156
Teichert – Reiff	**2016**	**20**	297	341	**0.996**	± 0.153
Teichert – Reiff	**2017**	**16**	355	677	**1.287**	± 0.197
Teichert – Reiff	**2018**	(no samples)				
Teichert – Reiff	**2019**	**10**	337	535	**0.637**	± 0.134
Teichert – Esparto	**2020**	**10**	369	742	**0.408**	± 0.123
Historic/Baseline Data						
Channel Catfish						
Rumsey	2000	1	411	565	0.225	
River Mile 28	**2011**	**5**	**239**	**102**	**0.229**	**± 0.102**
River Mile 20	2000	1	368	380	0.225	
River Mile 03	1997	10	336	304	0.174	± 0.019

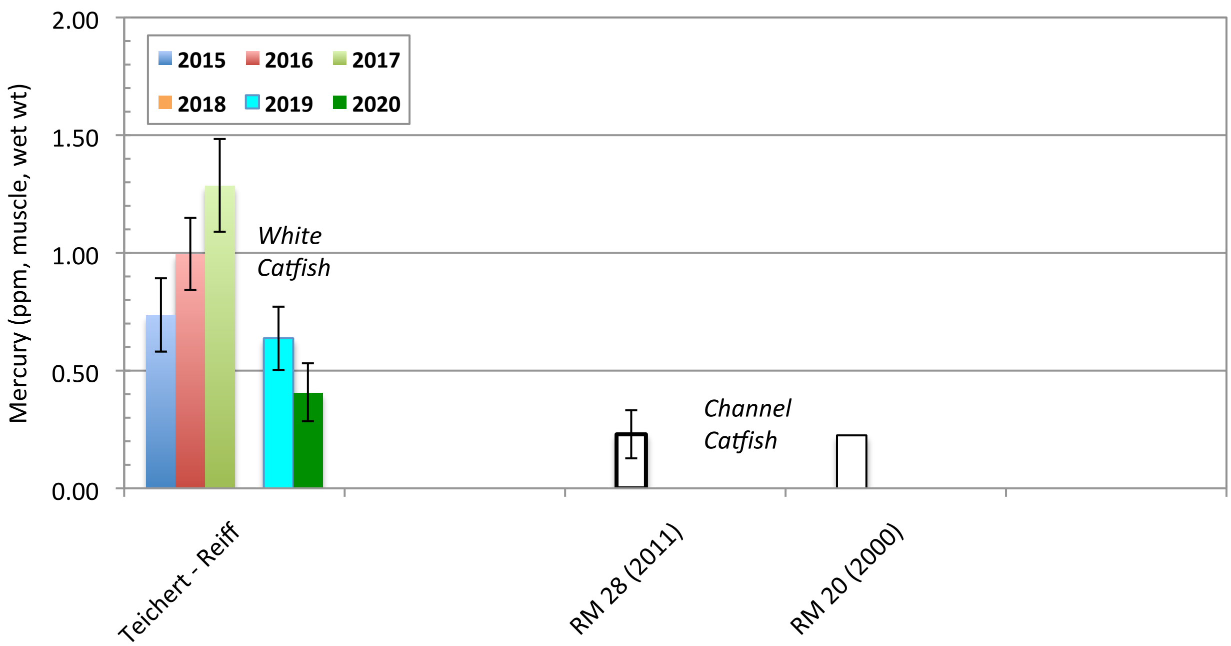

Figure 18. White Catfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 19. Carp summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Carp						
Teichert – Reiff	**2015**	**2**	421	918	**0.351**	
Teichert – Reiff	**2016**	**5**	430	975	**0.854**	± 0.387
Teichert – Reiff	**2017**	**9**	481	1,499	**1.122**	± 0.321
Teichert – Reiff	**2018**	(no samples)				
Teichert – Reiff	**2019**	**9**	483	1,475	**0.988**	± 0.279
Teichert – Esparto	**2020**	**7**	381	1,086	0.636	± 0.334
Historic/Baseline Data (most comparable species available)						
Sacramento Sucker						
Rumsey	2000	6	328	396	0.198	± 0.113
River Mile 20	2000	5	253	174	0.154	± 0.034
River Mile 15	**2011**	**8**	**276**	**231**	**0.143**	**± 0.011**
River Mile 08	2000	4	319	336	0.339	
River Mile 03	1997	5	343	402	0.263	± 0.068

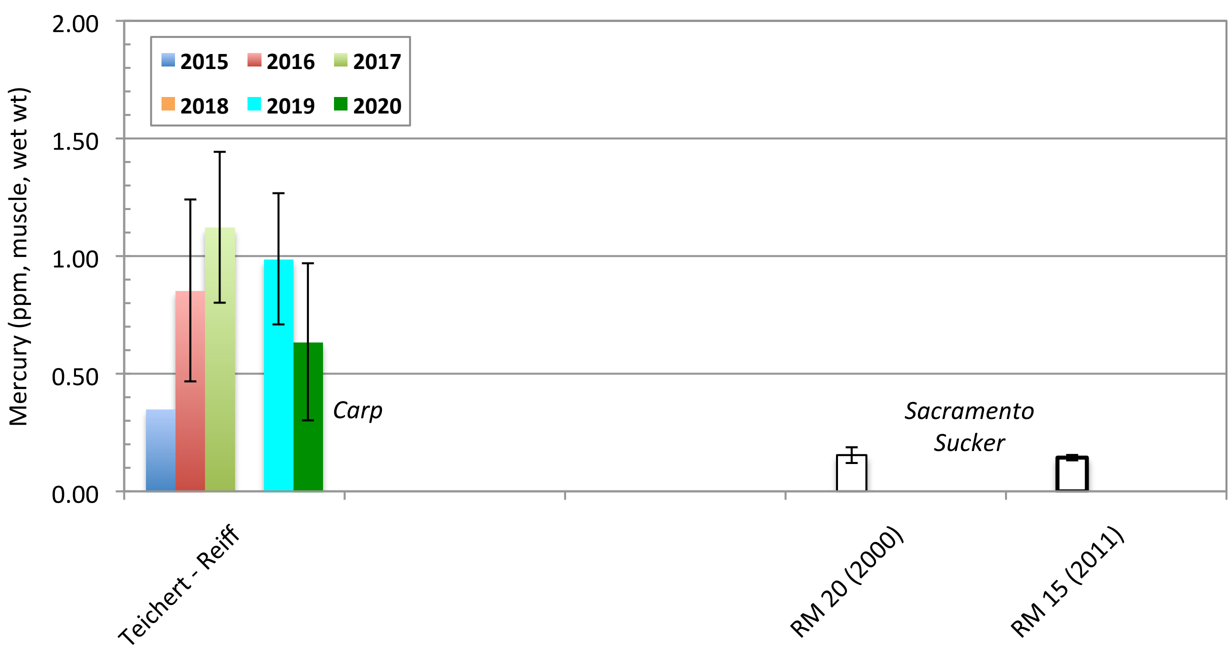

Figure 19. Carp summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 20. Teichert – Esparto Pond: Small Fish Sampled, 2020
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	Av. Fish Length (inches)	Av. Fish Weight (g)	Av. Fish Weight (oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	3	80	3.1	5.8	0.21	**0.400**
Largemouth Bass (juv)	3	88	3.5	7.8	0.28	**0.458**
Largemouth Bass (juv)	3	95	3.7	9.9	0.35	**0.517**
Largemouth Bass (juv)	3	103	4.1	12.7	0.45	**0.513**
Green Sunfish (juv)	3	29	1.1	0.39	0.014	**0.206**
Green Sunfish (juv)	3	31	1.2	0.49	0.017	**0.212**
Green Sunfish (juv)	3	35	1.4	0.71	0.025	**0.218**
Green Sunfish (juv)	3	43	1.7	1.27	0.045	**0.285**
Mosquitofish	12	27	1.1	0.21	0.008	**0.185**
Mosquitofish	12	33	1.3	0.34	0.012	**0.244**
Mosquitofish	2	41	1.6	0.78	0.028	**0.312**
Mosquitofish	1	47	1.9	1.35	0.048	**0.328**

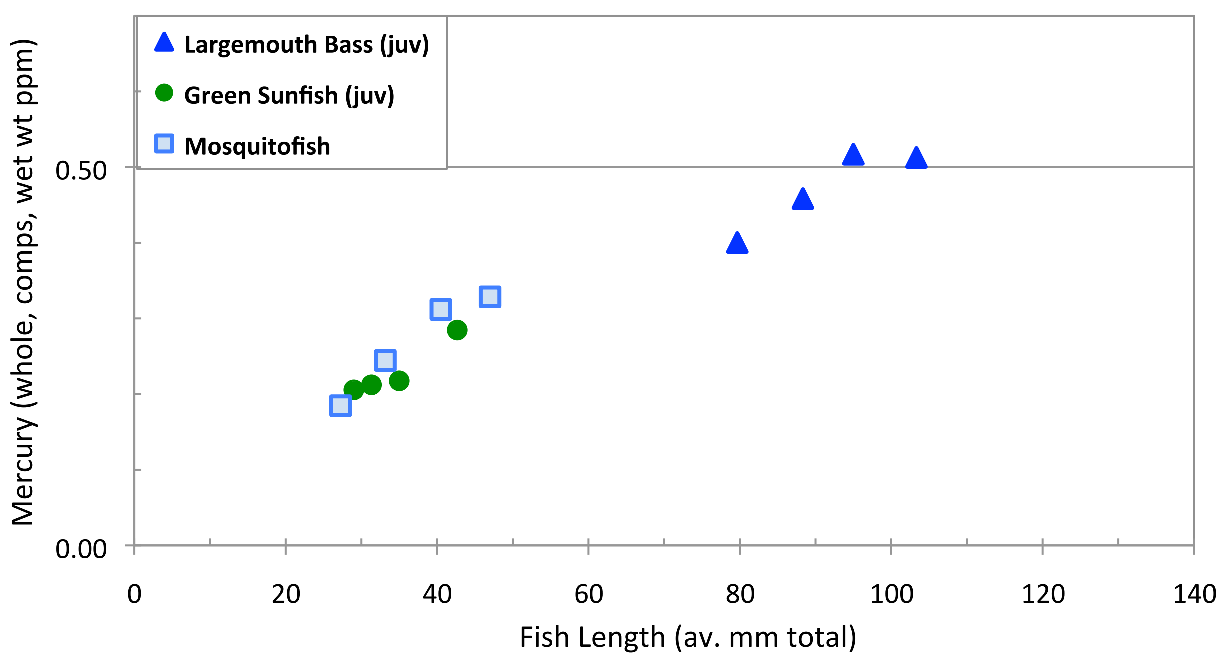

Figure 20. Teichert – Esparto Pond: small, young fish sampled, 2020
(mercury in whole-body, multi-individual composite samples)

Table 21. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Teichert – Reiff	**2015**	**4**	12	38	0.6	**0.094**	± 0.005
Teichert – Reiff	**2016**	**4**	10	36	0.5	**0.212**	± 0.021
Teichert – Reiff	**2017**	–	–	–	–	–	
Teichert – Reiff	**2018**	**4**	10	35	0.5	**0.262**	± 0.026
Teichert – Reiff	**2019**	**4**	5-10	33	0.4	**0.222**	± 0.041
Teichert – Esparto	**2020**	**4**	1-12	37	0.7	**0.267**	± 0.033
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

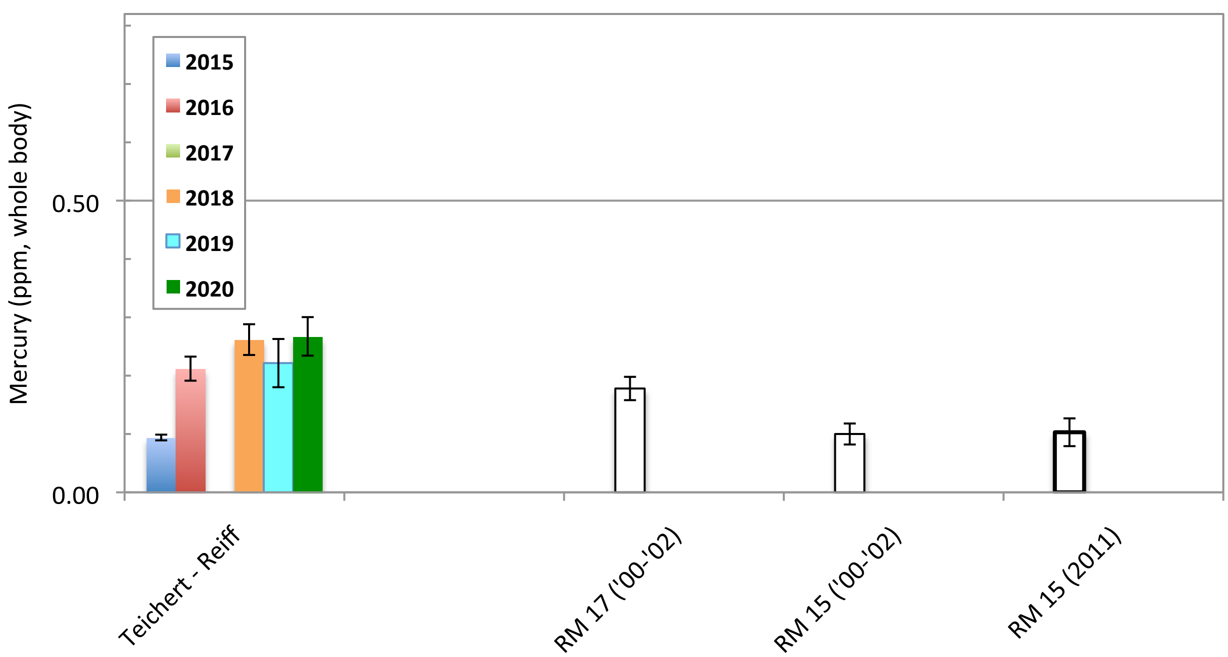

Figure 21. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 22. Red Shiner summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Red Shiners							
Teichert – Reiff	**2015**	**4**	10	50	1.3	**0.152**	± 0.009
Teichert – Reiff	**2016**	**4**	10	47	1.1	**0.412**	± 0.042
Teichert – Reiff	**2017**	**4**	10	49	1.1	**0.695**	± 0.070
Teichert – Reiff	**2018**	**4**	10	45	0.8	**0.556**	± 0.031
Teichert – Reiff	**2019**	*(Shiners not found in 2019 or 2020)*					
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**10**	**48**	**1.0**	**0.242**	**± 0.018**
River Mile 20	2000	3	9	42	0.6	0.166	± 0.002
River Mile 17	2000-2002	11	6-15	27-58	0.2-1.8	0.225	± 0.023
River Mile 15	1997	3	19	37	0.5	0.159	± 0.014
River Mile 15	2000-2002	13	6-12	30-60	0.2-2.0	0.131	± 0.005

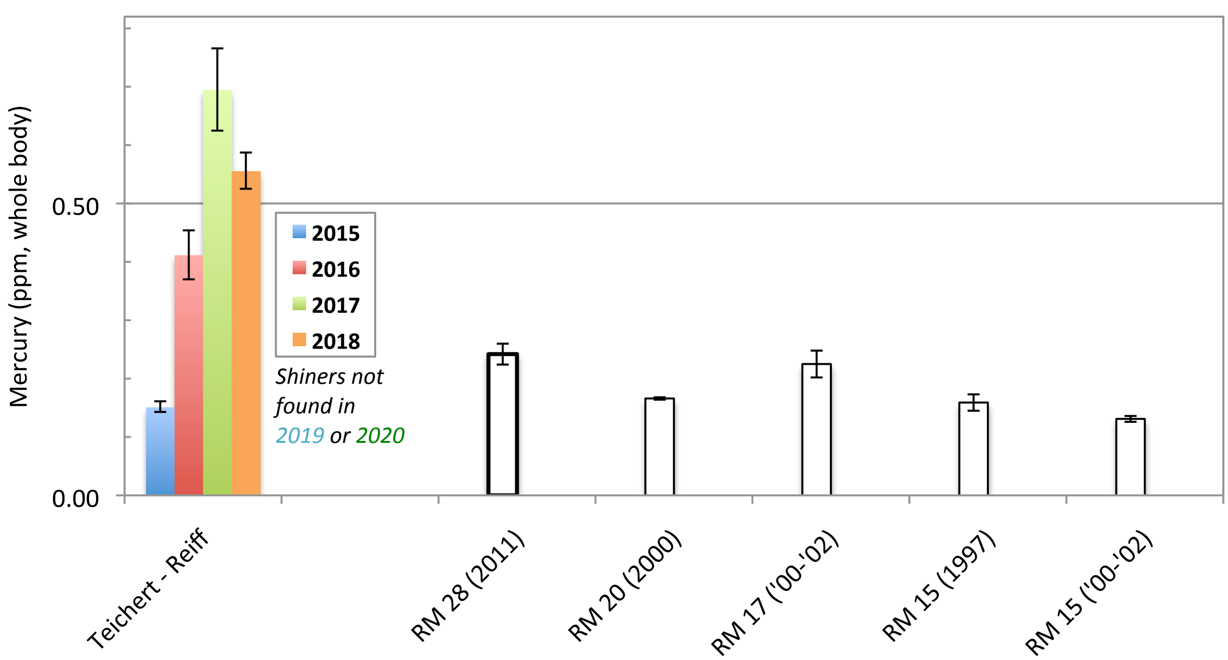

Figure 22. Red Shiner summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 23. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Teichert – Reiff	**2015**	**–**	–				
Teichert – Reiff	**2016**	**–**	–				
Teichert – Reiff	**2017**	**4**	1-2	137	32	**0.798**	± 0.094
Teichert – Reiff	**2018**	**4**	4-6	111	17	**0.445**	± 0.069
Teichert – Reiff	**2019**	**4**	5	107	15	**0.297**	± 0.010
Teichert – Esparto	**2020**	**4**	3	92	9	**0.472**	± 0.027
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

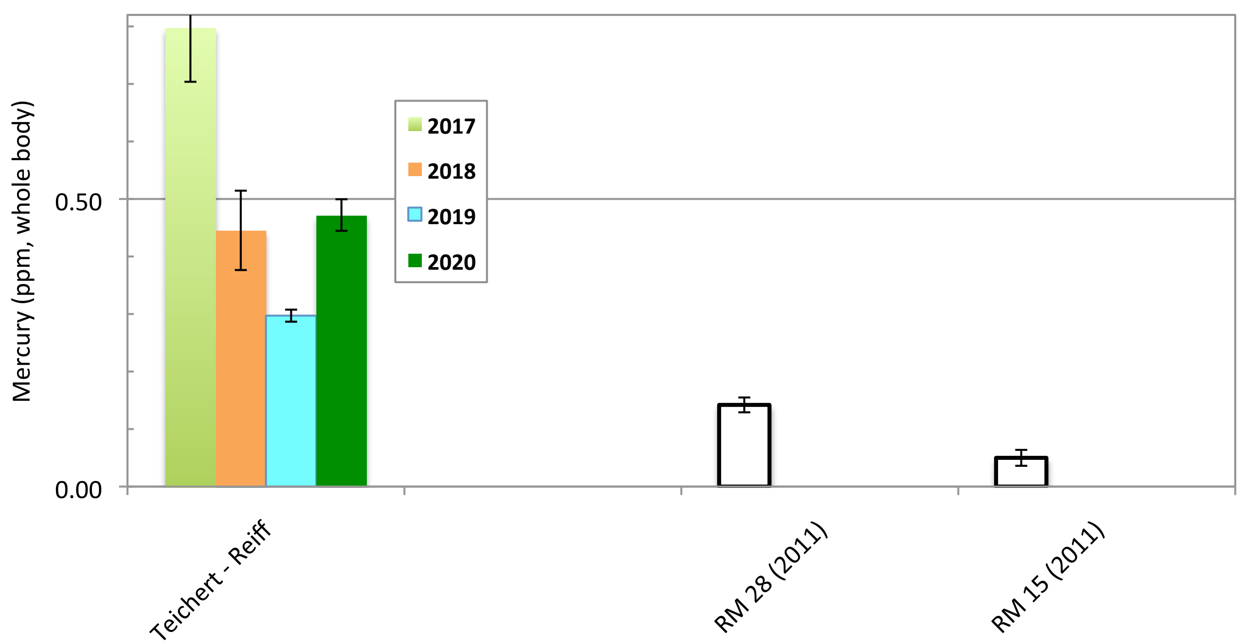

Figure 23. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 24. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Teichert – Reiff	**2015**	**1**	1	68	5.1	**0.241**	
Teichert – Reiff	**2016**	**–**	–				
Teichert – Reiff	**2017**	–	–				
Teichert – Reiff	**2018**	**4**	2	48	2.3	**0.252**	± 0.010
Teichert – Reiff	**2019**	**4**	3-10	41	1.3	**0.187**	± 0.029
Teichert – Esparto	**2020**	**4**	3	35	0.7	**0.230**	± 0.018
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.014**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.004**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.045
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.028
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.018**

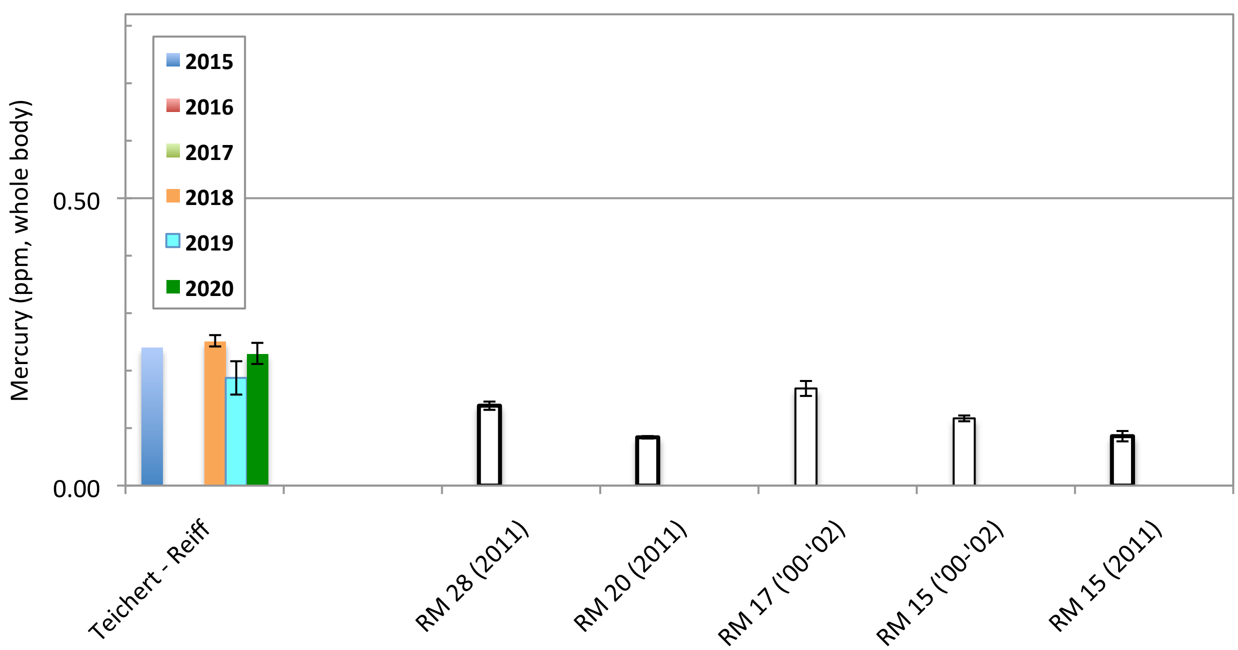

Figure 24. Juvenile Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

4. TEICHERT-WOODLAND – STORZ POND

(Google Earth 10/21/2020)

4. TEICHERT-WOODLAND – STORZ POND *(Tables and Figures 25-29)*

Summary

A sample of 20 small adult bass (the prevailing size) was taken, together with multiple composite samples of young-of-year Mosquitofish and juvenile Largemouth Bass. Adult bass showed a further drop in mercury levels in 2020, after decreasing in 2019 from already non-elevated concentrations. Across all sample types, fish mercury was the lowest here among the six monitored ponds. Relative to Cache Creek comparison data, Storz Pond continued to rank as "not elevated over baseline" in 2020 and is not flagged for expanded analysis or management planning. One-time-per-year routine water profiling has been added to the monitoring, following recent revisions of the mining ordinance.

Summary 2020 Teichert-Woodland – Storz Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	≤	≤	Largemouth Bass
		≤	Mosquitofish
Overall 2020 Findings	≤		

This pond is part of the Teichert–Woodland operations, located approximately 7 river miles downstream from the Reiff and Mast Ponds and Teichert–Esparto Plant. The Storz Pond is south of Cache Creek and just west of County Road 94b, near the Cache Creek Nature Preserve (which is located on the other, north, side of the creek). Our understanding is that it first become a wet pit in 2010-2011. The site has been relatively dormant and unmined over the course of mercury monitoring (since 2016); riparian and aquatic vegetation has colonized throughout, creating new habitat. Storz consists of 2 sub-basins that alternate between being connected and split, depending on runoff inputs and drought. By Fall 2020, with the onset of drought conditions, they were disconnected, as can be seen in the photo above. Together, they are approximately 150 m x 800 m in size. Depths in 2020 ranged to approximately 5 m (16').

We began sampling this site in 2016, but were unable to get our boat in at that time. By shore seining, we collected a good sample of Mosquitofish, (*Gambusia affinis*, 1-2") in 2016, but no additional species. In 2017, we were able to get our boat into the pond and sample more completely, making 2017 Year 1 of full sampling here. Since 2017, we have been able to collect Largemouth Bass (*Micropterus salmoides*) in addition to Mosquitofish. In 2020, 20 bass were taken in the low size range present of 193-242 mm (7-10"). The 20 bass were sampled for fillet muscle mercury. For small fish analyses, Mosquitofish were sampled with 4 size-class composites of 12 fish each, and juvenile Largemouth Bass with 4 individual samples. We were not able to collect additional juvenile bass, despite extensive seining.

In total, 20 large fish muscle samples and 8 small fish composite samples, or 28 separate mercury samples, were analyzed from the Teichert–Storz Pond in the Fall 2020 monitoring. The fish metrics and analytical results from each individual large bass muscle sample can be seen in Table 25 and, graphically, in Figure 25. Then, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2019 results and the most closely comparable historic creek data (Table and Figure 26). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 27-29.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 25 and 26)

As noted above, the bass samples consisted of 20 fish, all from the main cohort of fish present, in the small size range of 193-242 mm (7-10"). Fillet muscle mercury ranged between 0.146 and 0.285 ppm, averaging 0.193 ppm, statistically similar to last year (2019: 0.218 ppm). These were all very low mercury levels for bass in this watershed. As can be seen in Figure 26, the bass mercury levels in 2019 and 2020 were down dramatically from the levels of 2017 (0.657 ppm) and 2018 (0.611 ppm), which were moderate. Teichert–Storz had previously been the second lowest fish mercury pond in the monitoring program. But both the 2019 and 2020 sets of Storz fish were significantly lower in mercury than all other collections of bass, in this year or any previous year among all the monitored ponds. They also had significantly lower mercury than all of the historic baseline Cache Creek comparisons.

Small, Young Fish

Mosquitofish (Tables/Figures 27 and 28)

The Mosquitofish composite samples had whole-body mercury ranging from 0.044-0.080 ppm, averaging 0.059 ppm. This was significantly lower than in all previous collections from this site (0.087-0.282 ppm). As compared to baseline creek samples, the 2020 Storz Mosquitofish mercury levels were not elevated; they were significantly lower than all 3 of the creek data sets, which averaged 0.100-0.178 ppm.

Juvenile Largemouth Bass (Tables/Figures 27 and 29)

Juvenile bass were again very scarce, apparently due to cannibalism by larger bass, but we were able to collect 4 individuals. These were analyzed individually as whole fish like the other composites. Mercury levels ranged from 0.089-0.111 ppm, averaging 0.097 ppm. This was lower than last year (2019: 0.131 ppm; the difference was not quite significant statistically. Juvenile Bass mercury here remained far below the levels found in the first full monitoring year (2017: 0.337 ppm). It was also significantly lower than at all but one of the other monitored ponds (Cemex–Phase 1, 0.104 ppm). This was in spite of the Storz fish being significantly larger individuals (the only sizes available). As compared to the baseline samples from the creek, the 2020 Storz juvenile Largemouth Bass were, on average, not elevated; they were significantly lower in mercury than the River Mile 28 set (0.142 ppm) and significantly higher than the River Mile 15 set (0.050 ppm).

Table 25. Teichert-Woodland – Storz Pond: Individual large fish sampled, 2020

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	193	7.6	80	0.2	**0.175**
Largemouth Bass	194	7.6	80	0.2	**0.181**
Largemouth Bass	197	7.8	90	0.2	**0.239**
Largemouth Bass	198	7.8	75	0.2	**0.147**
Largemouth Bass	200	7.9	85	0.2	**0.283**
Largemouth Bass	202	8.0	85	0.2	**0.146**
Largemouth Bass	202	8.0	80	0.2	**0.156**
Largemouth Bass	205	8.1	90	0.2	**0.150**
Largemouth Bass	205	8.1	85	0.2	**0.150**
Largemouth Bass	205	8.1	105	0.2	**0.217**
Largemouth Bass	210	8.3	95	0.2	**0.221**
Largemouth Bass	211	8.3	95	0.2	**0.179**
Largemouth Bass	213	8.4	95	0.2	**0.155**
Largemouth Bass	215	8.5	105	0.2	**0.148**
Largemouth Bass	218	8.6	105	0.2	**0.208**
Largemouth Bass	220	8.7	112	0.2	**0.236**
Largemouth Bass	224	8.8	120	0.3	**0.183**
Largemouth Bass	229	9.0	120	0.3	**0.285**
Largemouth Bass	230	9.1	130	0.3	**0.223**
Largemouth Bass	242	9.5	155	0.3	**0.170**

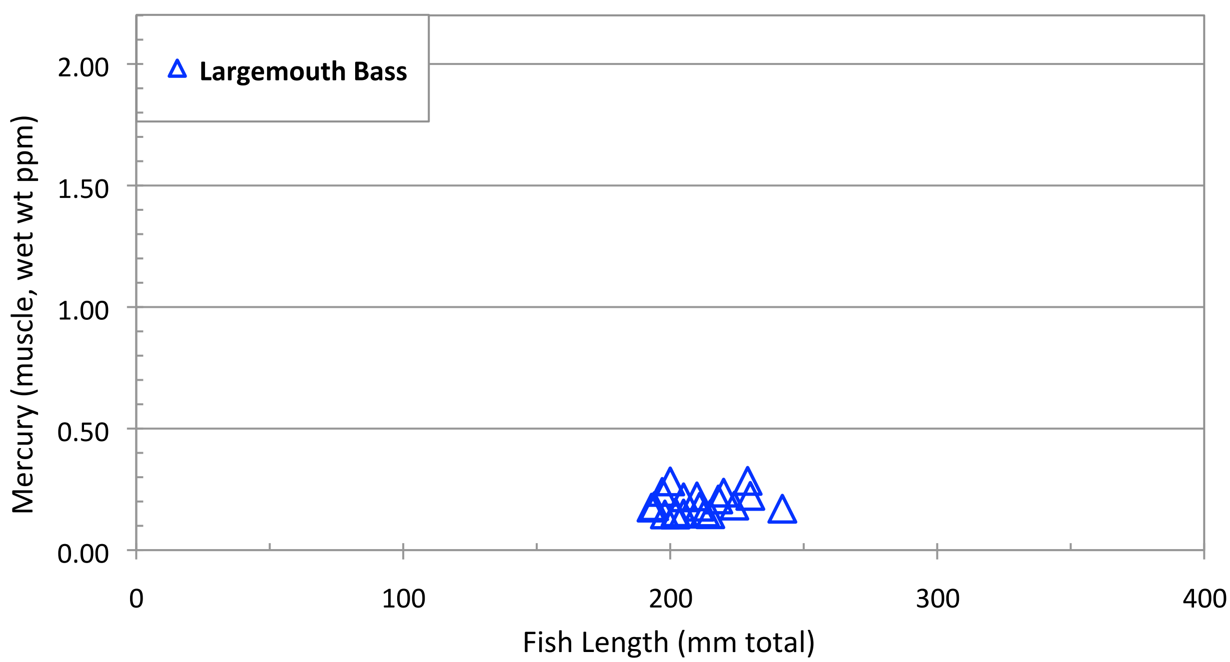

Figure 25. Teichert-Woodland – Storz Pond: Large Fish Sampled, 2020
(mean fillet muscle mercury, with 95% confidence intervals)

Table 26. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Teichert – Storz	2017	**20**	245	203	**0.657**	± 0.038
Teichert – Storz	2018	20	255	197	**0.611**	± 0.082
Teichert – Storz	2019	12	222	196	**0.218**	± 0.042
Teichert – Storz	2020	20	211	99	**0.193**	± 0.021
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

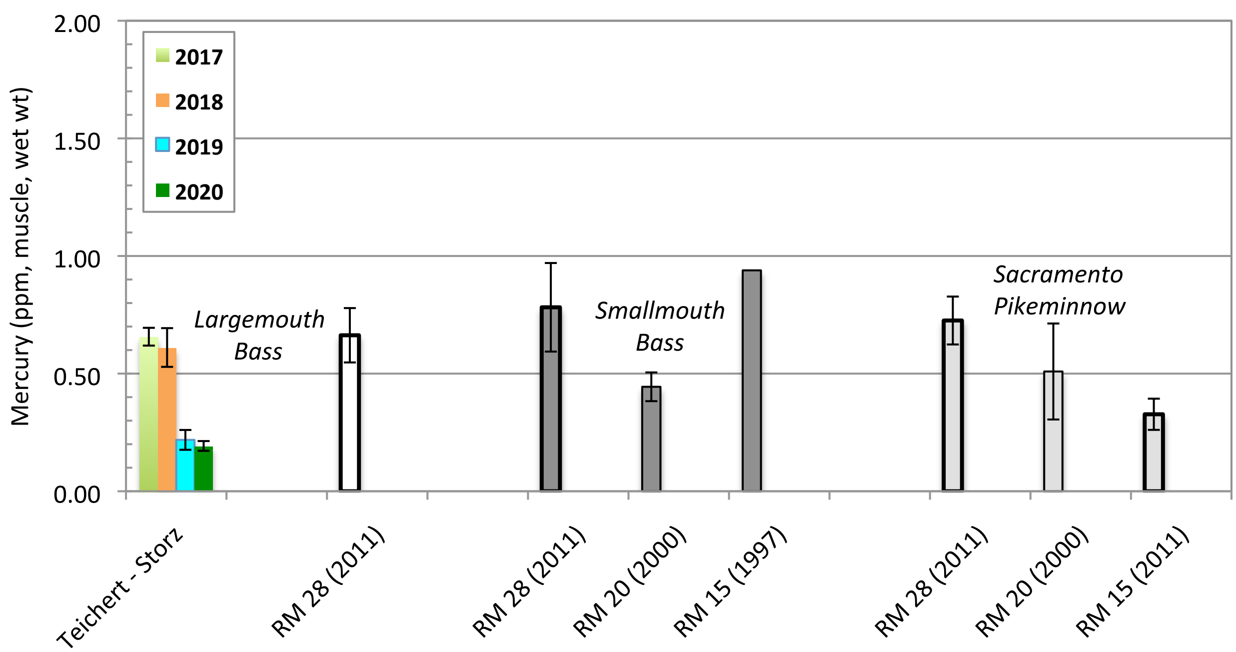

Figure 26. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 27. Teichert-Woodland – Storz Pond: Small Fish Sampled, 2020
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	Av. Fish Length (inches)	Av. Fish Weight (g)	Av. Fish Weight (oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	1	169	6.7	59.7	2.10	**0.111**
Largemouth Bass (juv)	1	171	6.7	64.1	2.26	**0.097**
Largemouth Bass (juv)	1	173	6.8	64.7	2.28	**0.089**
Largemouth Bass (juv)	1	174	6.9	63.4	2.24	**0.092**
Mosquitofish	12	28	1.1	0.19	0.007	**0.044**
Mosquitofish	12	31	1.2	0.32	0.011	**0.050**
Mosquitofish	12	33	1.3	0.47	0.017	**0.061**
Mosquitofish	12	37	1.5	0.67	0.024	**0.080**

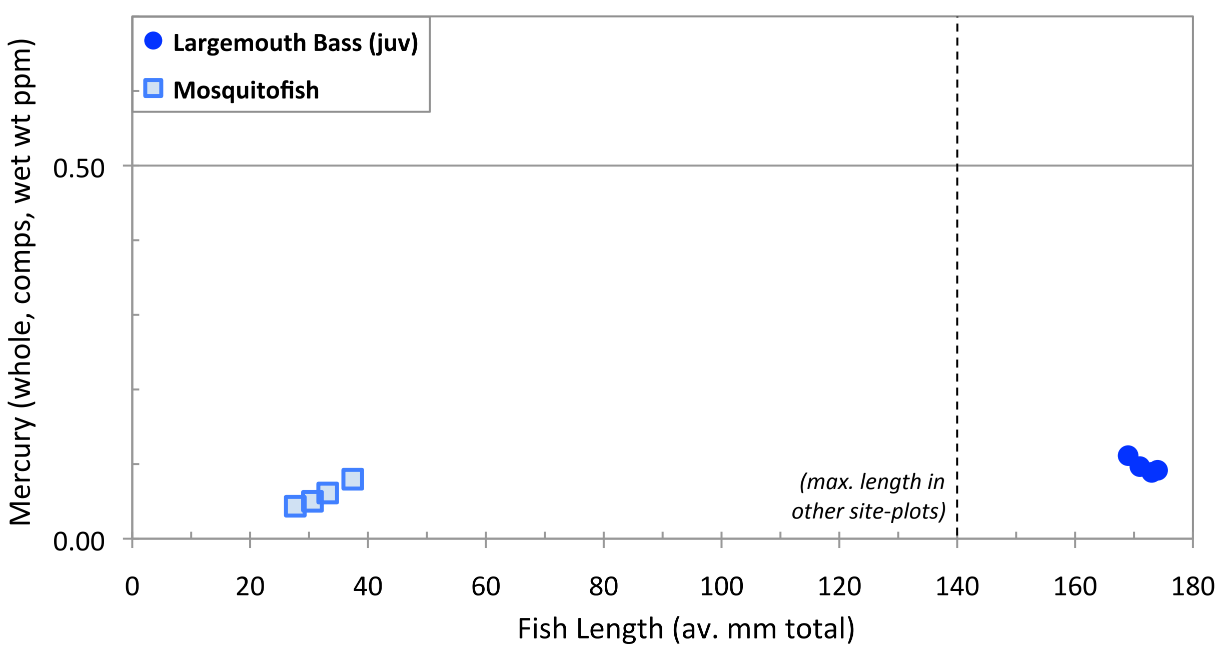

Figure 27. Teichert-Woodland – Storz Pond: Small Fish Sampled, 2020
(mercury in whole-body, multi-individual composite samples)

Table 28. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Teichert – Storz	**2016**	**4**	10	35	0.5	**0.229**	± 0.054
Teichert – Storz	**2017**	**4**	8-10	29	0.2	**0.282**	± 0.011
Teichert – Storz	**2018**	**4**	10	30	0.3	**0.087**	± 0.017
Teichert – Storz	**2019**	**4**	6-10	33	0.4	**0.200**	± 0.018
Teichert – Storz	**2020**	**4**	12	32	0.4	**0.059**	± 0.008
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

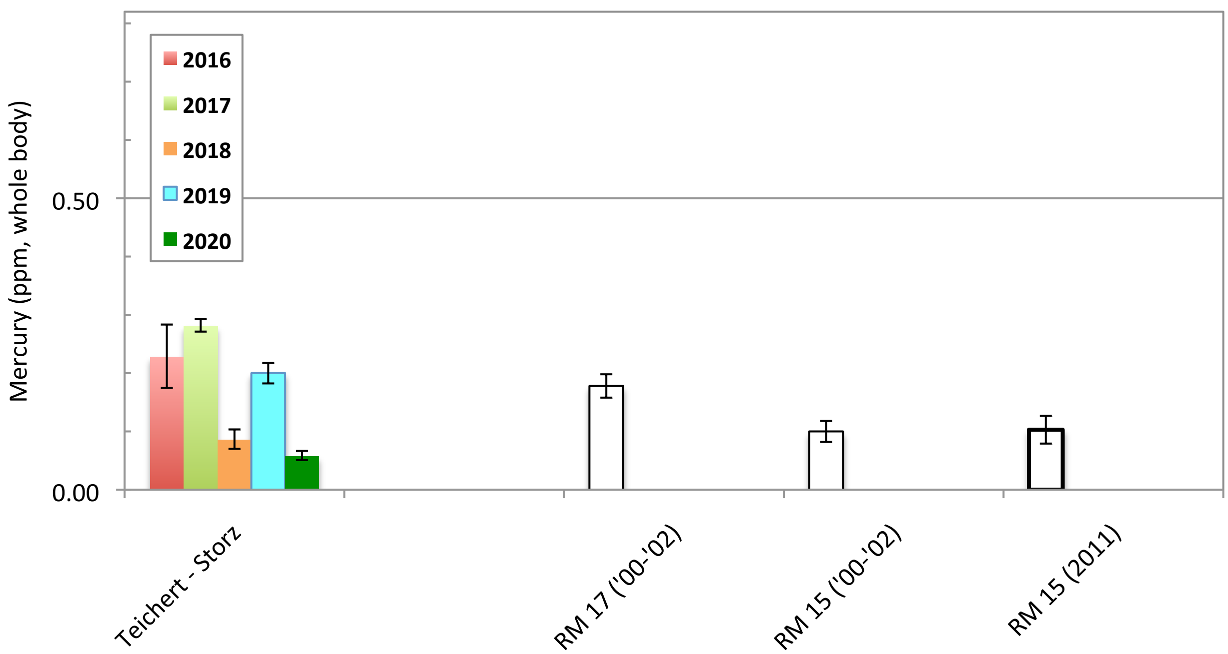

Figure 28. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 29. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Teichert – Storz	**2017**	**4**	1	143	35	**0.337**	± 0.030
Teichert – Storz	**2018**	–	–				
Teichert – Storz	**2019**	**4**	1	130	29	**0.131**	± 0.036
Teichert – Storz	**2020**	**4**	1	172	63	0.097	± 0.005
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

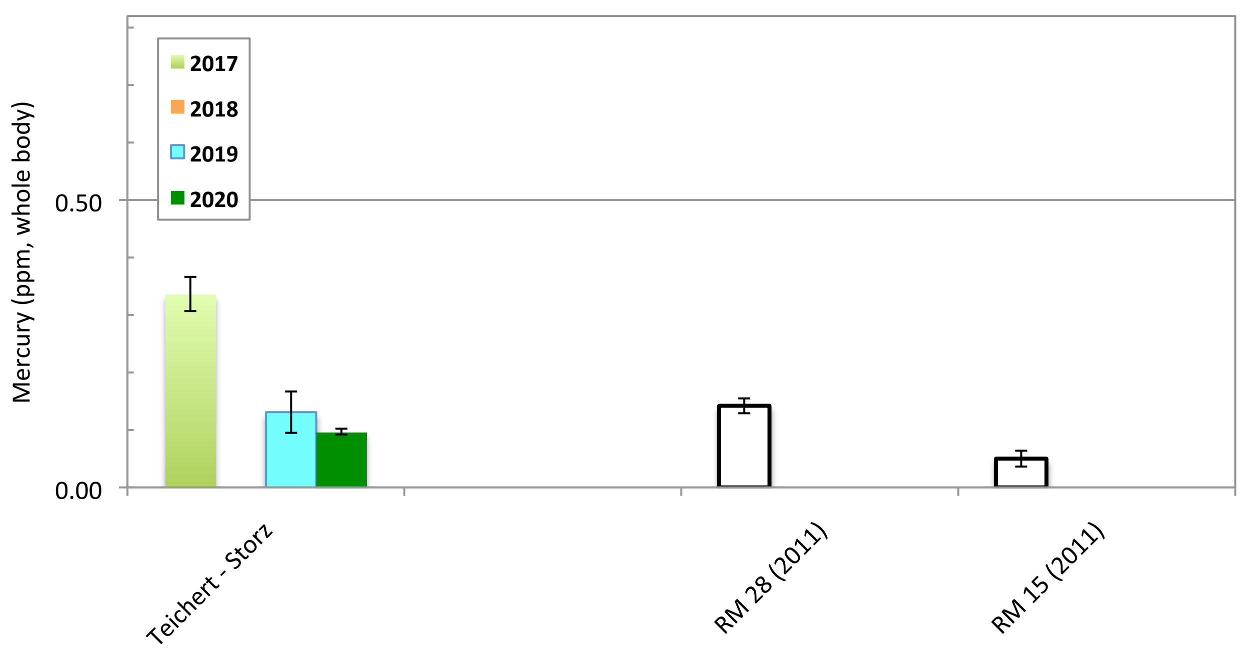

Figure 29. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

5. SYAR–B1 POND

(Google Earth 10/21/2020)

5. SYAR–B1 POND *(Tables and Figures 30-36)*

Summary

Nineteen adult Largemouth Bass were sampled, and ten adult Bluegill Sunfish. Young-of-year small fish collections included composites of Mosquitofish, juvenile Largemouth Bass, and juvenile Bluegill Sunfish. Adult fish mercury rose slightly over 2019 (not significantly) but remained significantly lower than the peak levels found here in 2015-2016. Small fish samples all showed a decline. Despite the relative drop in recent years, B1 Pond fish mercury in 2020 was still significantly higher on average than most baseline Cache Creek comparisons. Because of the overall status of the B1 Pond as "elevated over baseline in three or more years of five" (all years since 2015), water column profiling and collection of bottom sediments was started here in 2018, in support of the development of a lake management plan. That work is detailed in accompanying reports.

Summary 2020 Syar–B1 Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	>	>	Largemouth Bass
Sunfish	>	≤	Mosquitofish
		>	Sunfish
Overall 2020 Findings	>		

The Syar Cache Creek mining operation, begun before 2002, has been idle since 2011 and remained inactive throughout the 6 years it has been monitored (2015-2020). The site is located south of Cache Creek and west of Highway 505, between 505 and County Road 87. There are two mid-sized ponds at the site. We were provided access to the eastern pond of the two since 2015, and refer to that as the Syar–B1 Pond. It has an irregular shape about 500 m (0.5 km) long and 100-200 m wide. Beginning in 2017, we have also sampled the western pond (Syar–West), discussed in the next section. This (2020) was Year 6 of monitoring for the Syar–B1 Pond. The B1 Pond is located in a steep-sided surrounding depression. Maximum depth throughout the 2020 sampling year dropped from 9.3 m (31 feet) in May to 7.9 m (26 feet) in October. The shorelines are mostly steep, with the main area of the pond at a similar depth, within a meter or two of maximum depth.

As at the other sites, we sampled the B1 Pond during day, twilight, and night conditions on multiple days and with a range of techniques. The 2020 collections included a set of 19 Largemouth Bass (*Micropterus salmoides*) and 10 adult Bluegill Sunfish (*Lepomis macrochirus*) for fillet muscle samples. The small, young fish present were juvenile Largemouth Bass (2-4"), juvenile Bluegill Sunfish (*Lepomis macrochirus*, 1-2") and Mosquitofish (*Gambusia affinis*, 1-2"). The Sunfish and Mosquitofish were each sampled with four extensive multi-individual composites. Only four individual juvenile Bass were found; these were analyzed individually, whole-body like the other composites.

In total, 29 large fish muscle samples and 12 young, small fish composite samples, or 41 separate mercury samples, were analyzed from the Syar–B1 Pond in the Fall 2020 monitoring. The fish metrics and analytical results from each individual large fish muscle sample can be seen in Table 30 and, graphically, in Figure 30. Then, for each large fish species taken, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2019 results and the most closely comparable historic creek data (Tables and Figures 31-32). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 33-36.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 30 and 31)

The B1 Pond adult Largemouth Bass samples included 19 fish across the range of adult sizes present: 252-403 mm (10-16") in length and 205-1020 g (0.4-2.2 lbs) in weight. They had fillet muscle mercury ranging from 0.558-1.810 ppm, increasing steadily with fish size and averaging 1.095 ppm. This was up slightly, but statistically unchanged, from the previous three years

(2017-2019: 0.904-0.980 ppm) and remained significantly down from the levels found in 2015-2016 when they averaged 1.628 and 1.640 ppm, which were extremely high fish mercury levels. As compared to baseline samples from Cache Creek though, the 2021 B1 Pond adult Largemouth Bass remained clearly elevated in mercury; they were significantly higher than all comparison sets. Concentrations generally increased with fish size; the three largest, highest mercury fish averaged 1.741 ppm. From a human (or wildlife) health perspective, the larger fish clearly present the greater hazard, as at the other ponds.

Green Sunfish / Bluegill Sunfish (Tables/Figures 30 and 32)

Ten adult Bluegill Sunfish were sampled, for the first time here. They appear to have largely replaced Green Sunfish as the dominant sunfish in both of the Syar ponds. The data are presented together with the previous results from Green Sunfish. The 2020 Bluegill samples ranged in size from 145-166 mm (5-7"). Muscle mercury ranged between 0.532 and 0.767 ppm, averaging 0.602 ppm. This was up from last year (2019: 0.457 ppm), though, with only a 2-fish sample last year, the difference cannot be assessed statistically. Similar to the bass trend, this remained down (significantly) from the initial sunfish data we have for this pond (2015-2016: 0.777-1.446 ppm). However, relative to baseline Cache Creek Green Sunfish comparisons, the 2020 B1 Pond adult Bluegill Sunfish mercury remained elevated; higher than all baseline sets. The difference was statistically significant for all but one of the comparisons.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 33 and 34)

The juvenile bass samples, even at these small sizes (2.6-4.3"), showed increasing mercury levels with size, ranging from 0.168-0.416 ppm and averaging 0.259 ppm. This average was down significantly from 2019 (0.338 ppm) and all previous years (2015-2018: 0.368-0.589 ppm). Interestingly, the B1 Pond juvenile bass have come down in mercury each year since 2015. Relative to baseline comparison data from Cache Creek though, they still remained elevated; significantly higher than the two sample sets available: River Mile 28 (0.142 ppm) and River Mile 15 (0.050 ppm).

Juvenile Sunfish (Tables/Figures 33 and 35)

This year, Bluegill Sunfish became the dominant juvenile sunfish species present here, largely replacing Green Sunfish. Four extensive size-class composite samples were taken. As mentioned for some of the other sites, at these small sizes the two sunfish species are functionally equivalent, accumulating mercury in a comparable way. The 2020 juvenile Bluegill Sunfish composites had whole-body mercury of 0.137-0.224 ppm, averaging 0.181 ppm. This was lower than comparable samples in all of the previous five years (2015-2019: 0.225-0.414 ppm), significantly lower than four of the five years. Similar to the juvenile bass, the juvenile sunfish here in 2017-2020 have had significantly lower mercury than in the initial monitoring years of 2015 and 2016. Relative to baseline juvenile Green Sunfish comparison numbers from Cache Creek though, the 2020 B1 Pond juvenile sunfish remained elevated. The difference was statistically significant for four of the five comparisons.

Mosquitofish (Tables/Figures 33 and 36)

The Mosquitofish samples had whole-body mercury ranging tightly from 0.067-0.191 ppm, averaging 0.130 ppm. This was down significantly from 2019 (0.214 ppm) and, consistent with the other two small fish species, was the lowest average Mosquitofish mercury level found at this site since monitoring began in 2015. Also similar to the other species, levels in recent years have remained significantly lower than in the initial monitoring years (2015-2017: 0.268-0.309 ppm). Relative to the baseline Cache Creek data, the 2020 B1 Pond Mosquitofish mercury levels were, for the first time, not elevated. They were statistically similar to two of the three comparison sets and significantly lower than one.

Table 30. Syar – B1 Pond: Individual large fish sampled, 2020

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	252	9.9	205	0.5	**0.805**
Largemouth Bass	262	10.3	235	0.5	**0.558**
Largemouth Bass	266	10.5	235	0.5	**0.975**
Largemouth Bass	267	10.5	185	0.4	**1.230**
Largemouth Bass	270	10.6	250	0.6	**0.860**
Largemouth Bass	272	10.7	225	0.5	**0.906**
Largemouth Bass	278	10.9	265	0.6	**0.891**
Largemouth Bass	279	11.0	255	0.6	**0.996**
Largemouth Bass	288	11.3	285	0.6	**1.007**
Largemouth Bass	289	11.4	295	0.7	**1.116**
Largemouth Bass	292	11.5	290	0.6	**0.921**
Largemouth Bass	294	11.6	315	0.7	**0.856**
Largemouth Bass	295	11.6	295	0.7	**1.069**
Largemouth Bass	296	11.7	310	0.7	**1.475**
Largemouth Bass	298	11.7	320	0.7	**0.838**
Largemouth Bass	327	12.9	385	0.8	**1.078**
Largemouth Bass	368	14.5	495	1.1	**1.708**
Largemouth Bass	385	15.2	710	1.6	**1.810**
Largemouth Bass	403	15.9	1020	2.2	**1.705**
Bluegill Sunfish	145	5.7	43	0.1	**0.600**
Bluegill Sunfish	148	5.8	45	0.1	**0.532**
Bluegill Sunfish	149	5.9	45	0.1	**0.561**
Bluegill Sunfish	153	6.0	55	0.1	**0.579**
Bluegill Sunfish	157	6.2	63	0.1	**0.662**
Bluegill Sunfish	160	6.3	65	0.1	**0.542**
Bluegill Sunfish	164	6.5	80	0.2	**0.560**
Bluegill Sunfish	164	6.5	69	0.2	**0.767**
Bluegill Sunfish	165	6.5	75	0.2	**0.649**
Bluegill Sunfish	166	6.5	85	0.2	**0.571**

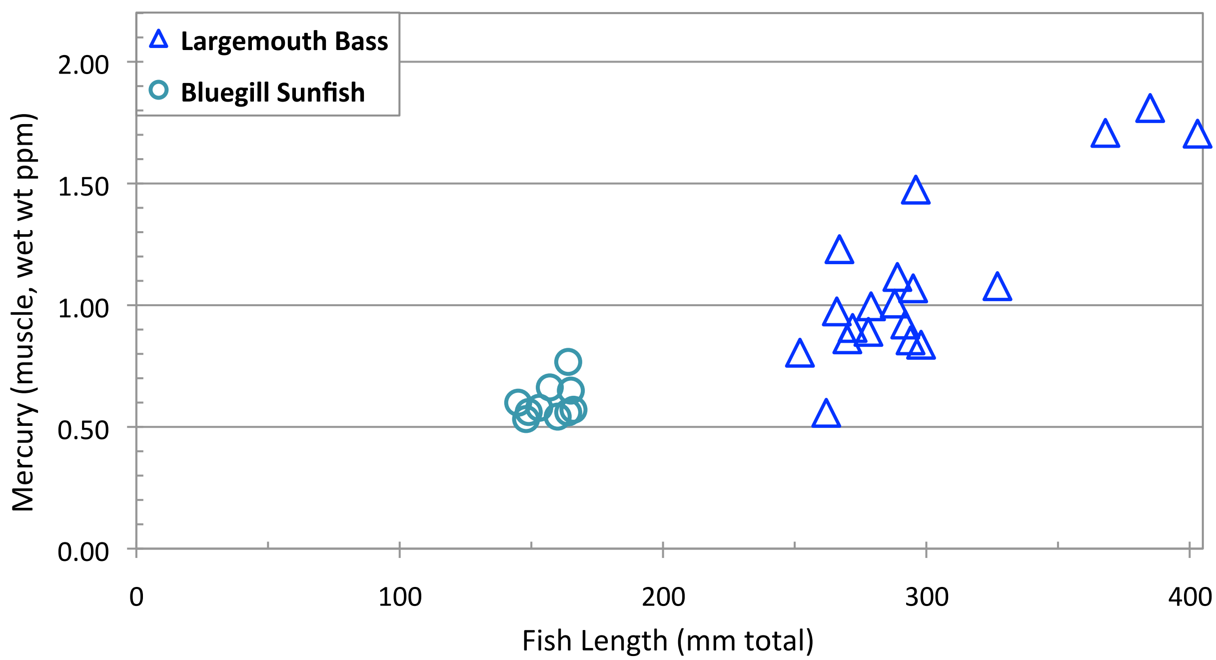

Figure 30. **Syar – B1 Pond: large fish sampled, 2020**
(fillet muscle mercury in individual fish)

Table 31. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Syar – B1	2015	**18**	281	355	**1.628**	± 0.332
Syar – B1	2016	**20**	318	489	**1.640**	± 0.152
Syar – B1	2017	**16**	260	265	**0.904**	± 0.239
Syar – B1	2018	20	295	335	**0.977**	± 0.198
Syar – B1	2019	20	307	377	**0.980**	± 0.192
Syar – B1	2020	19	299	346	**1.095**	± 0.165
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

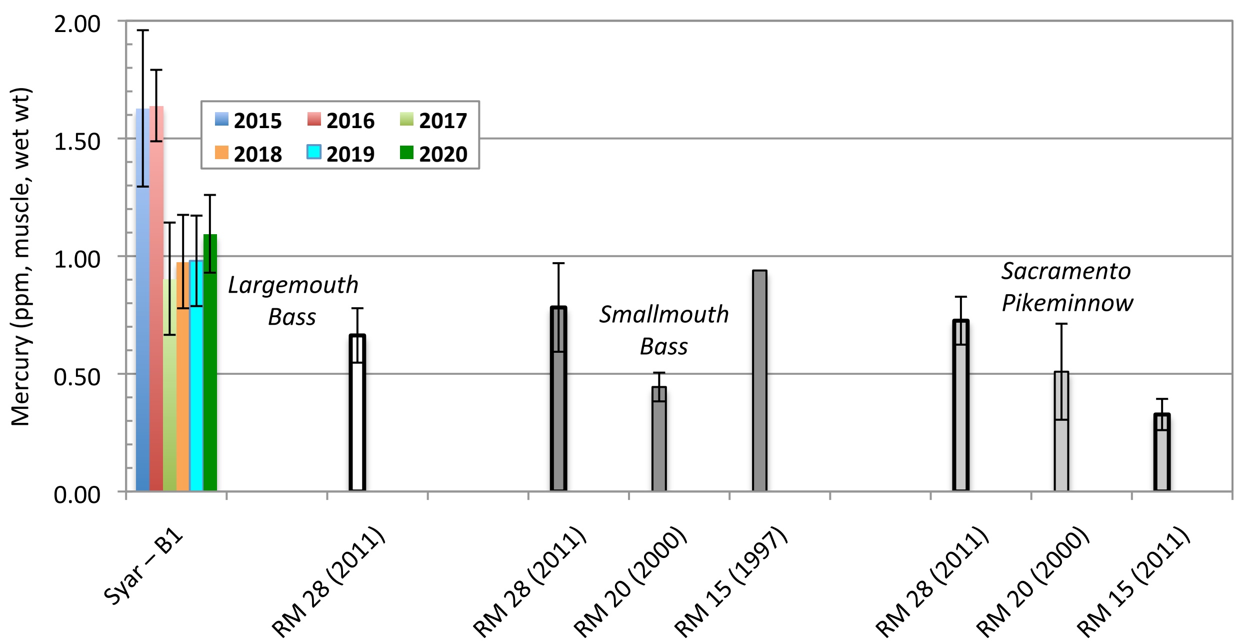

Figure 31. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 32. Green and Bluegill Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish						
Syar – B1	2015	**10**	118	25	**0.777**	± 0.086
Syar – B1	2016	**1**	83	12	**1.446**	
Syar – B1	2017	–				
Syar – B1	2018	–				
Syar – B1	2019	**2**	102	17	**0.457**	
Bluegill Sunfish						
Syar – B1	2020	10	157	63	**0.602**	± 0.051
Historic/Baseline Data (Green Sunfish)						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

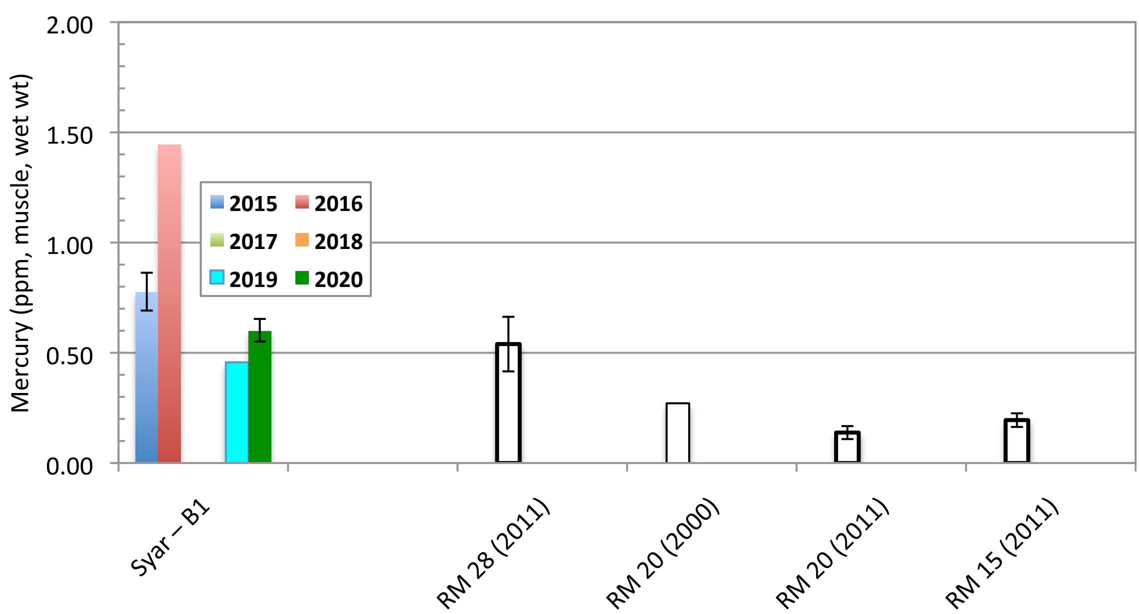

Figure 32. Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 33. Syar – B1 Pond: Small Fish Sampled, 2020
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	**n** (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Largemouth Bass (juv)	1	67	2.6	2.7	0.10	**0.168**
Largemouth Bass (juv)	1	84	3.3	7.6	0.27	**0.207**
Largemouth Bass (juv)	1	88	3.5	8.5	0.30	**0.245**
Largemouth Bass (juv)	1	108	4.3	15.9	0.56	**0.416**
Bluegill Sunfish (juv)	12	35	1.4	0.59	0.021	**0.137**
Bluegill Sunfish (juv)	12	43	1.7	1.11	0.039	**0.189**
Bluegill Sunfish (juv)	12	47	1.9	1.61	0.057	**0.174**
Bluegill Sunfish (juv)	12	53	2.1	2.08	0.074	**0.224**
Mosquitofish	12	27	1.1	0.22	0.008	**0.067**
Mosquitofish	12	32	1.3	0.38	0.013	**0.118**
Mosquitofish	12	36	1.4	0.50	0.018	**0.145**
Mosquitofish	6	41	1.6	0.78	0.027	**0.191**

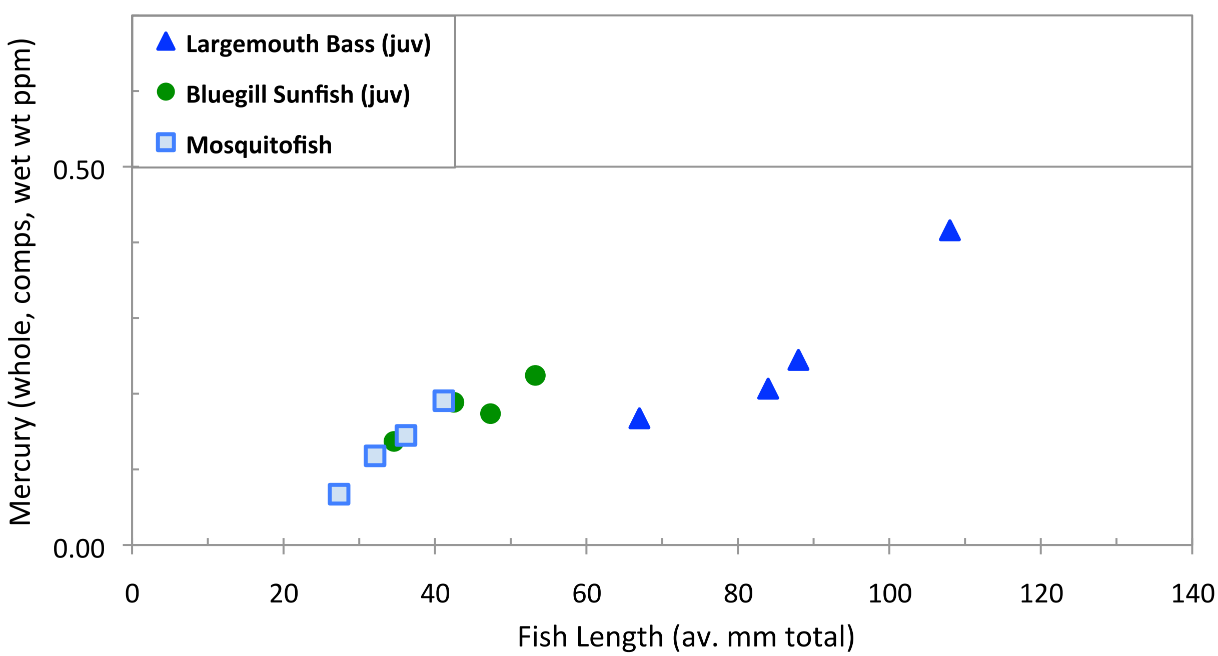

Figure 33. Syar – B1 Pond: small, young fish sampled, 2020
(mercury in whole-body, multi-individual composite samples)

Table 34. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	**Year**	**n** (comps)	**n** (inds/ (comp)	**Av Lgth** (mm total)	**Av Wt** (grams)	**Hg** (µg/g = ppm, wet wt)	**Std. Error**
Largemouth Bass (juveniles)							
Syar – B1	**2015**	**4**	7	159	44	**0.589**	± 0.030
Syar – B1	**2016**	**4**	10	74	5	**0.524**	± 0.119
Syar – B1	**2017**	**4**	1-2	102	18	**0.461**	± 0.175
Syar – B1	**2018**	**4**	2	88	9	**0.368**	± 0.040
Syar – B1	**2019**	**4**	1	87	7	**0.338**	± 0.021
Syar – B1	**2020**	**4**	1	87	9	**0.259**	± 0.055
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

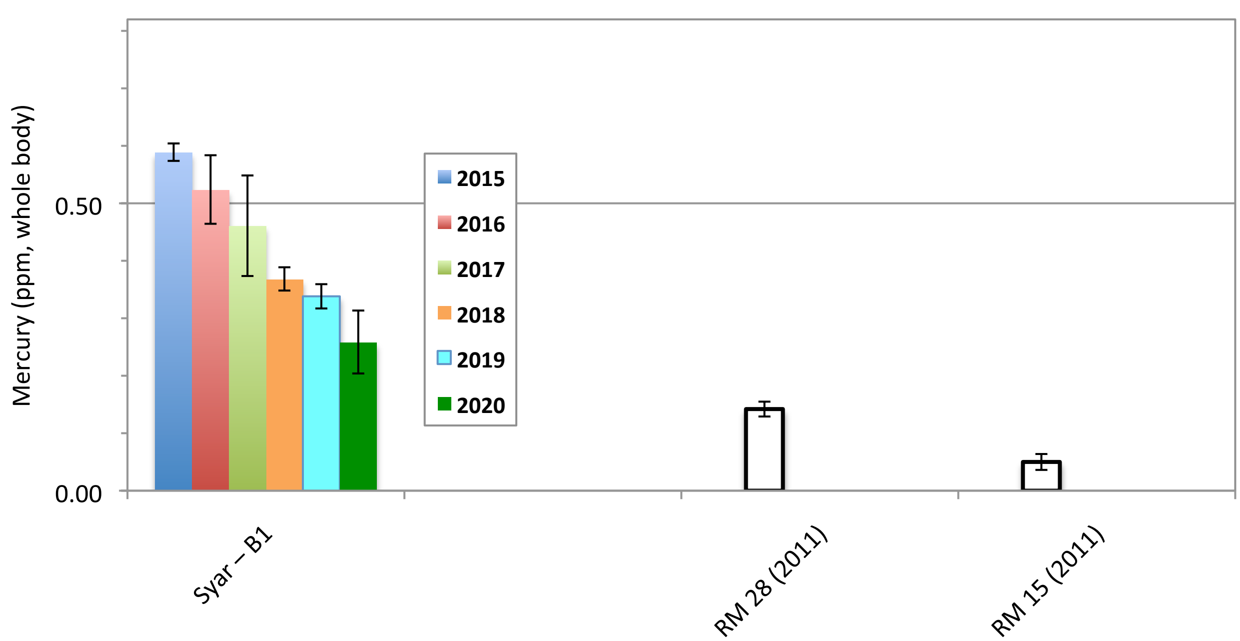

Figure 34. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 35. Juvenile Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Syar – B1	**2015**	**4**	8-9	47	1.7	**0.325**	± 0.097
Syar – B1	**2016**	**4**	4	50	1.9	**0.414**	± 0.076
Syar – B1	**2017**	**4**	6-7	40	1.0	**0.225**	± 0.069
Syar – B1	**2018**	**4**	10	37	0.8	**0.231**	± 0.044
Syar – B1	**2019**	**4**	8-10	45	1.5	**0.245**	± 0.016
Bluegill Sunfish (juveniles)							
Syar – B1	**2020**	**4**	12	44	1.3	**0.181**	± 0.018
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

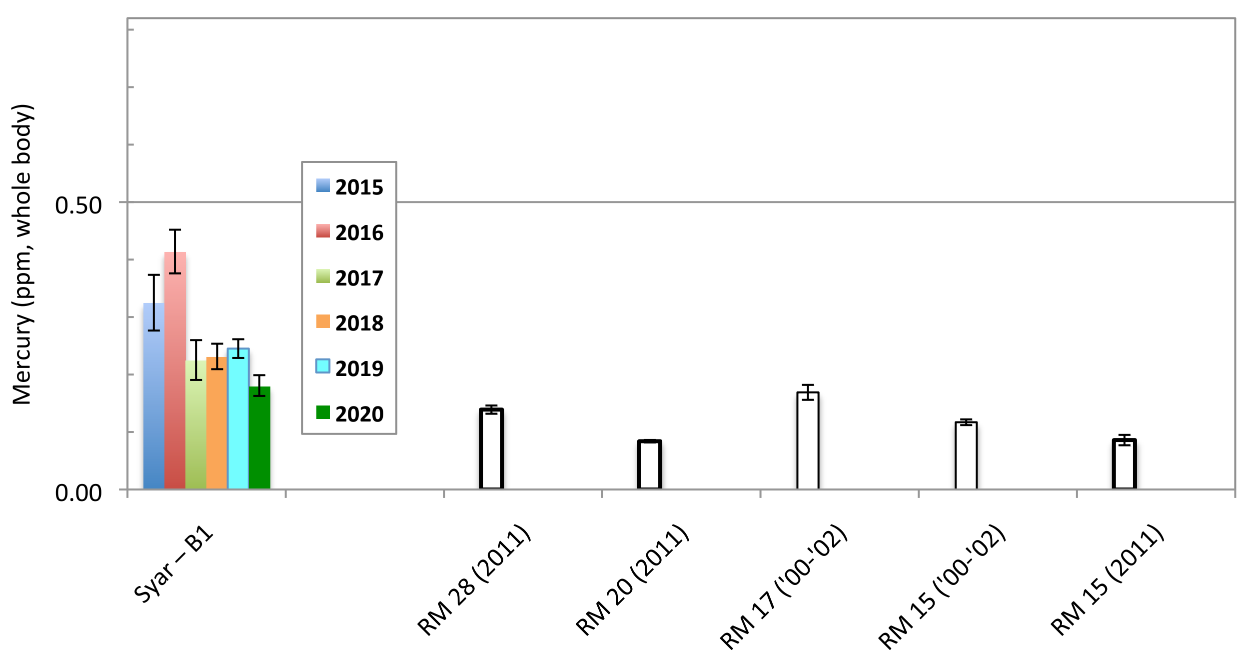

Figure 35. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 36. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Syar – B1	**2015**	**4**	5-10	31	0.3	**0.268**	± 0.043
Syar – B1	**2016**	**–**	–	–	–	**–**	
Syar – B1	**2017**	**4**	9-10	35	0.4	**0.309**	± 0.110
Syar – B1	**2018**	**4**	6-9	31	0.4	**0.163**	± 0.056
Syar – B1	**2019**	**3**	1-3	38	0.7	**0.214**	± 0.011
Syar – B1	**2020**	**4**	6-12	34	0.5	**0.130**	± 0.026
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

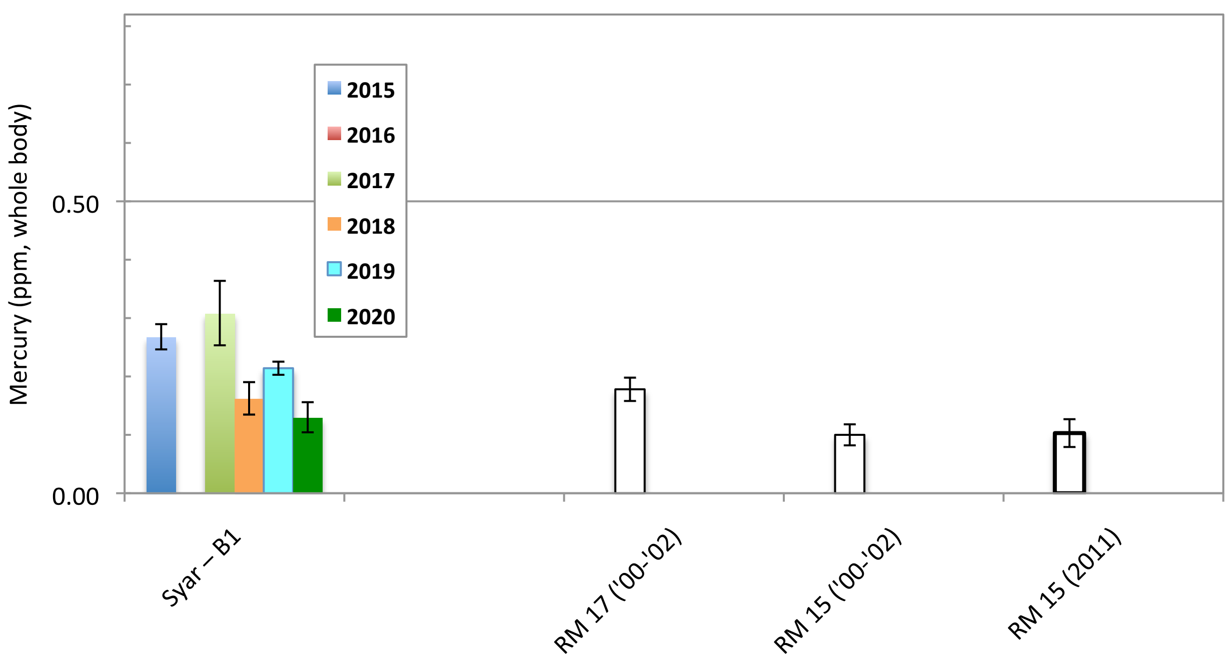

Figure 36. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

6. SYAR–WEST POND

(Google Earth 10/21/2020)

6. SYAR–WEST POND *(Tables and Figures 37-43)*

Summary

Nineteen adult Largemouth Bass were sampled, and ten adult Bluegill Sunfish. Young-of-year small fish collections included multiple composites of Mosquitofish and juvenile Bluegill Sunfish. On average, the 2020 fish Syar-West were significantly elevated over baseline in 2020, as in 2017 and 2019. That makes "three or more years of five elevated over baseline" as specified in the Ordinance, triggering the requirement for expanded analysis and development of a lake management plan. Expanded analyses have in fact been conducted here since 2018, as a second control/reference site. This pond is far deeper than the other ponds currently, and is representative of the range of final depths projected at several of the sites. With elevated fish mercury status as of 2020, this work will help in the development of a lake management plan.

Summary 2020 Syar–West Results, in relation to baseline comparisons

≤ = at or below ambient INC = inconclusive > = elevated over ambient

	Large/Adult Fish	Young-of-Year Fish	
Largemouth Bass	>	≤	Mosquitofish
Sunfish	>	>	Sunfish
Overall 2020 Findings	>		

This pond is located about half a kilometer west of the B1 Pond; the overall Syar site and its history is described above in the section on the B1 Pond. The West Pond is approximately 300 m x 400 m in size. It has been dormant and unmined since 2011. The basin is considerably deeper than all of the other ponds in the monitoring program at this time, with extensive areas more than 15 m (50 feet) deep, under normal conditions. In 2020, maximum water levels were 16.3-17.4 m (53-57 ft). The Syar–West Pond was added to the monitoring program in 2017, in line with the Ordinance. This (2020) was Year 4 of monitoring for the site.

As at the other sites, we sampled the West Pond during day, twilight, and night conditions on multiple days with a range of techniques. We were able to obtain fillet muscle samples of 19 Largemouth Bass (*Micropterus salmoides*) and 10 adult Bluegill Sunfish (*Lepomis macrochirus*). The small, young fish present were juvenile juvenile Bluegill Sunfish (1-2", 4 multi-individual composite samples) and Mosquitofish (*Gambusia affinis*, 1-2", 4 composites), for 8 total multi-individual composite samples. Juvenile Largemouth Bass were not found this year.

In total, 29 large fish muscle samples and 8 small fish composite samples, or 37 separate mercury samples, were analyzed from the Syar–West Pond in the Fall 2020 monitoring. The fish metrics and analytical results from each individual large fish muscle sample can be seen in Table 37 and, graphically, in Figure 37. Then, for each large fish species taken, the new data are shown in reduced form (means, error bars, etc) and compared to 2015-2019 results and the most closely comparable historic creek data (Tables and Figures 38-39). Results from the composite samples of small, young-of-year fish are similarly presented in Tables and Figures 40-43.

Large, Angling-sized Fish

Largemouth Bass (Tables/Figures 37 and 38)

Nineteen bass were sampled, across the size range present: 233-362 mm (9-14") in length and 160-505 g (0.4-1.1 lbs) in weight. The bass samples had fillet muscle mercury ranging from 0.493-1.732 ppm, increasing generally with size. As noted in the nearby B1 Pond, the bulk of the fish clustered in a narrower range of concentrations (0.493-1.133, mean = 0.783 ppm, n=16), while the three highest mercury fish, among the largest individuals of the set, averaged 1.537 ppm. The overall average bass mercury in 2021 was 0.902 ppm. This was up, though not significantly statistically, from 2019 (0.672 ppm) and 2018 (0.798 ppm). Levels in 2020 were similar to the highest levels found here (2017: 0.925 ppm). This was statistically similar to the levels found in similar bass from the nearby B1 Pond (2017-2020: 0.904-1.095 ppm). Relative to historic/baseline creek comparisons, the 2020 West Pond adult Largemouth Bass were elevated in mercury; they were higher than six of the seven comparison data sets; the elevation was statistically significant for three of the comparisons.

Green Sunfish / Bluegill Sunfish (Tables/Figures 37 and 39)

Ten adult Bluegill Sunfish were sampled, for the first time here. They appear to have largely replaced Green Sunfish as the dominant sunfish in both of the Syar ponds. The data are presented with the previous results from Green Sunfish. The 2021 Bluegill samples ranged in size from 170-203 mm (6-8"). Muscle mercury ranged between 0.489 and 0.839 ppm, averaging 0.612 ppm. This was statistically similar to levels in similar samples taken from the nearby B1 Pond (2020: 0.602 ppm). As compared to historic baseline samples of Green Sunfish from Cache Creek, the 2020 West Pond Bluegill Sunfish were elevated in mercury; higher than all four baseline sets, significantly higher than two of the three with enough samples to assess statistically.

Small, Young Fish

Juvenile Largemouth Bass (Tables/Figures 40 and 41)

We were not able to collect young bass from the West Pond in 2020. Data from previous years are shown in the figure and table.

Juvenile Bluegill Sunfish (Tables/Figures 40 and 42)

As found in the B1 Pond, juvenile Bluegill Sunfish have mostly replaced Green Sunfish in the West Pond. As noted earlier, at the small sizes used for this monitoring, the two sunfish species are functionally equivalent and inter-comparable in their mercury accumulation. We collected extensive composite samples in the same size ranges used for the other sunfish. They had whole-body mercury ranging from 0.138-0.233 ppm, averaging 0.187 ppm. This was up slightly from 2019 (0.177 ppm); the difference was not statistically significant. It was significantly greater than the lowest levels found here (2018: 0.102 ppm), and lower than the highest levels seen (2017: 0.237 ppm). In comparison to matching 2021 samples from the adjacent B1 Pond, West Pond mercury levels were identical. Relative to baseline/historic juvenile Green Sunfish comparisons from Cache Creek, the 2020 Syar–West samples were elevated in mercury levels on average; statistically similar to one baseline set and significantly higher than four.

Mosquitofish (Tables/Figures 40 and 43)

We were able to collect four size-class composite samples of 8-12 Mosquitofish each in 2020, an improvement over the last two years when they were very scarce. The composites had whole-body mercury ranging from 0.072-0.158 ppm, averaging 0.109 ppm. This was down significantly from 2019 (0.165 ppm) and 2017 (0.236 ppm), and was statistically similar to the lowest levels found here to-date (2018: 0.088 ppm). In comparison to matching 2021 samples from the adjacent B1 Pond (0.130 ppm), West Pond mercury levels were statistically similar. As compared to baseline Cache Creek sampling, the 2020 West Pond Mosquitofish mercury levels were not elevated; they were statistically similar to two of the baseline sets and significantly lower than one.

Table 37. Syar – West Pond: Individual large fish sampled, 2020

Fish Species	Fish Total Length (mm)	(inches)	Fish Weight (g)	(lbs)	Muscle Mercury (µg/g = ppm, wet wt)
Largemouth Bass	233	9.2	160	0.4	**0.621**
Largemouth Bass	257	10.1	205	0.5	**0.710**
Largemouth Bass	257	10.1	195	0.4	**0.843**
Largemouth Bass	264	10.4	210	0.5	**0.891**
Largemouth Bass	277	10.9	225	0.5	**0.731**
Largemouth Bass	282	11.1	240	0.5	**0.894**
Largemouth Bass	282	11.1	245	0.5	**1.133**
Largemouth Bass	286	11.3	285	0.6	**0.493**
Largemouth Bass	293	11.5	315	0.7	**0.609**
Largemouth Bass	294	11.6	335	0.7	**0.730**
Largemouth Bass	304	12.0	330	0.7	**0.942**
Largemouth Bass	305	12.0	355	0.8	**0.721**
Largemouth Bass	305	12.0	350	0.8	**0.511**
Largemouth Bass	310	12.2	348	0.8	**0.997**
Largemouth Bass	312	12.3	402	0.9	**0.884**
Largemouth Bass	315	12.4	210	0.5	**1.732**
Largemouth Bass	333	13.1	415	0.9	**1.467**
Largemouth Bass	338	13.3	505	1.1	**0.822**
Largemouth Bass	362	14.3	450	1.0	**1.413**
Bluegill Sunfish	170	6.7	100	0.2	**0.614**
Bluegill Sunfish	173	6.8	90	0.2	**0.611**
Bluegill Sunfish	174	6.9	98	0.2	**0.608**
Bluegill Sunfish	182	7.2	105	0.2	**0.672**
Bluegill Sunfish	183	7.2	115	0.3	**0.614**
Bluegill Sunfish	185	7.3	115	0.3	**0.839**
Bluegill Sunfish	188	7.4	125	0.3	**0.534**
Bluegill Sunfish	193	7.6	140	0.3	**0.585**
Bluegill Sunfish	195	7.7	145	0.3	**0.550**
Bluegill Sunfish	203	8.0	175	0.4	**0.489**

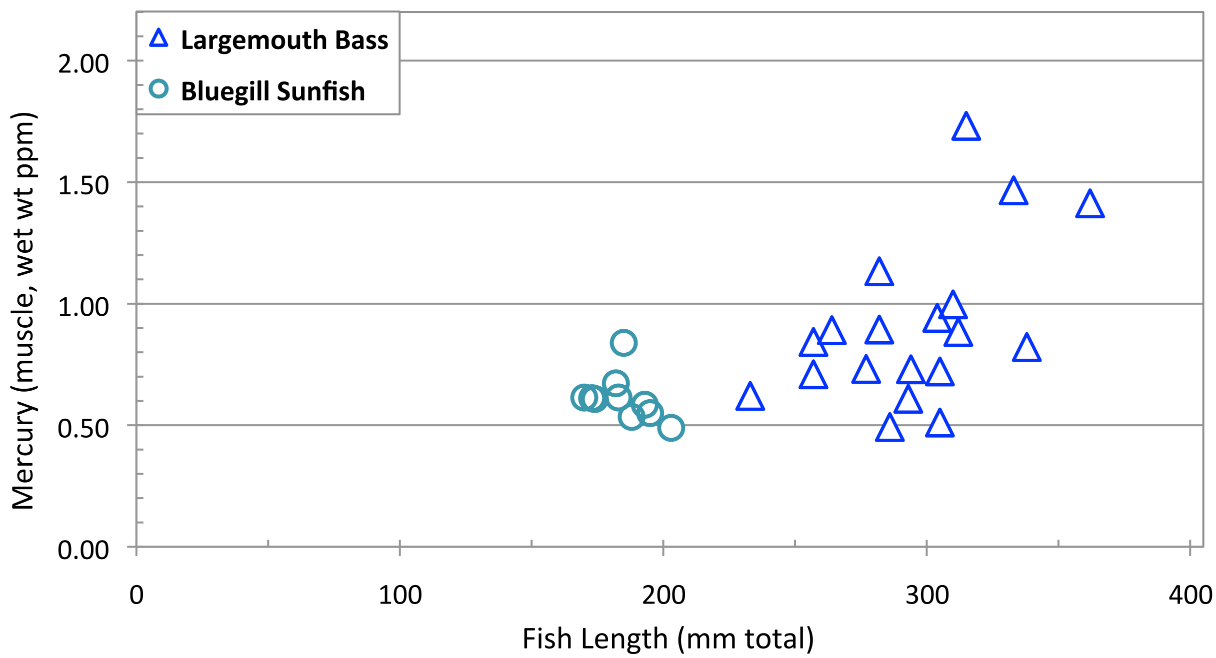

Figure 37. **Syar – West Pond: large fish sampled, 2020**
(fillet muscle mercury in individual fish)

Table 38. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Syar – West	**2017**	**17**	283	320	**0.925**	± 0.205
Syar – West	**2018**	20	278	292	**0.798**	± 0.229
Syar – West	**2019**	20	275	271	**0.672**	± 0.105
Syar – West	**2020**	19	295	304	**0.902**	± 0.159
Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

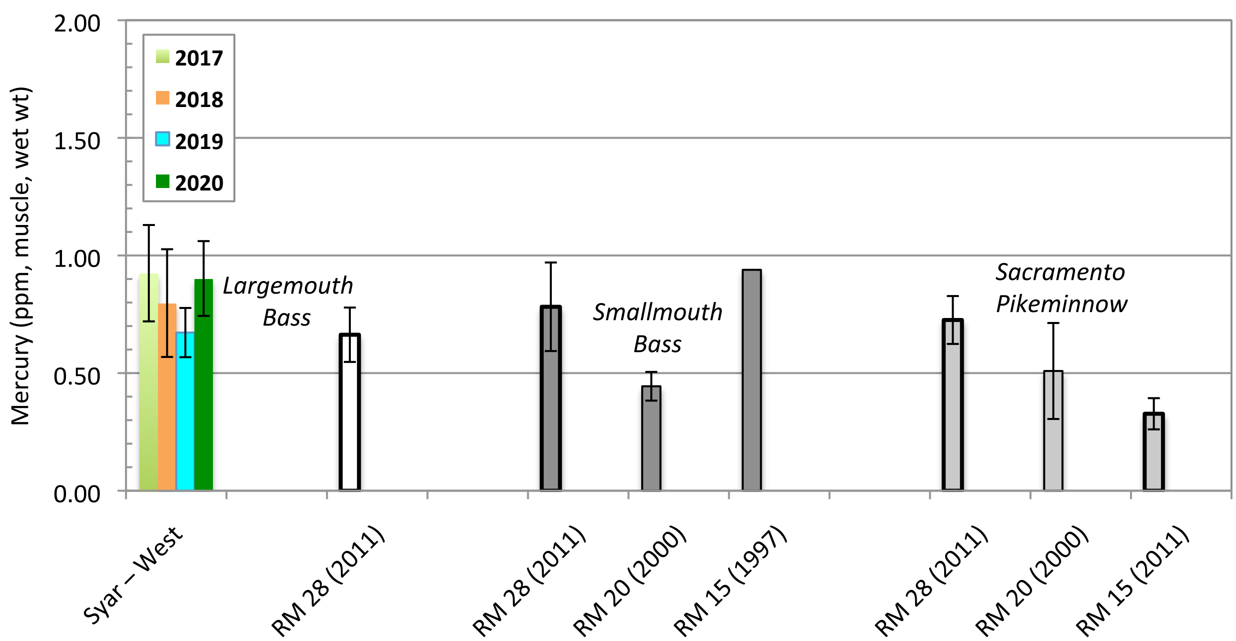

Figure 38. Largemouth Bass summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 39. Green and Bluegill Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish						
Syar – West	**2017**	**4**	93	12	**0.579**	± 0.089
Syar – West	**2018**	**–**				
Syar – West	**2019**	**1**	126	41	**0.238**	
Bluegill Sunfish						
Syar – West	**2020**	10	185	121	**0.612**	± 0.068
Historic/Baseline Data						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

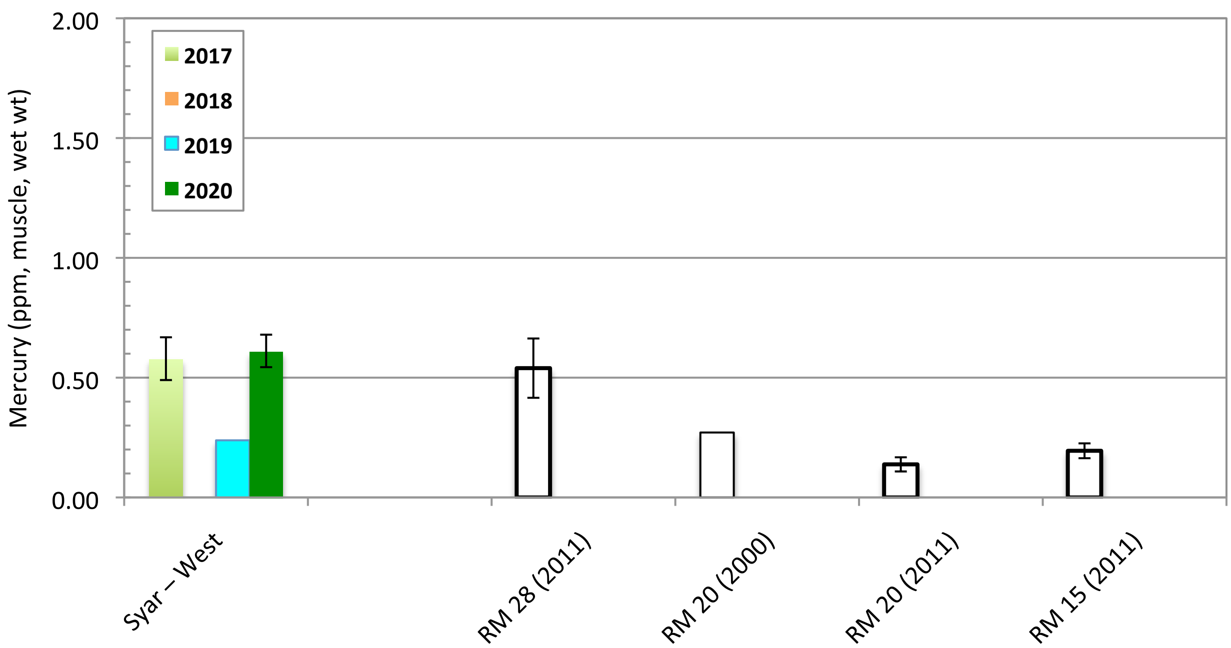

Figure 39. Sunfish summary data, and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 40. **Syar – West Pond: Small Fish Sampled, 2020**
(multi-individual, whole body composite samples)
'**n**' = *number: number of individual fish per composite*

Fish Species	n (indivs. in comp)	Av. Fish Length (mm)	(inches)	Av. Fish Weight (g)	(oz)	Whole-Body Mercury (µg/g = ppm, wet wt)
Bluegill Sunfish (juv)	10	32	1.3	0.48	0.017	**0.138**
Bluegill Sunfish (juv)	12	40	1.6	0.98	0.034	**0.156**
Bluegill Sunfish (juv)	12	45	1.8	1.33	0.047	**0.222**
Bluegill Sunfish (juv)	12	51	2.0	2.03	0.072	**0.233**
Mosquitofish	12	27	1.1	0.23	0.008	**0.072**
Mosquitofish	12	33	1.3	0.42	0.015	**0.098**
Mosquitofish	12	37	1.4	0.56	0.020	**0.110**
Mosquitofish	8	42	1.6	0.83	0.029	**0.158**

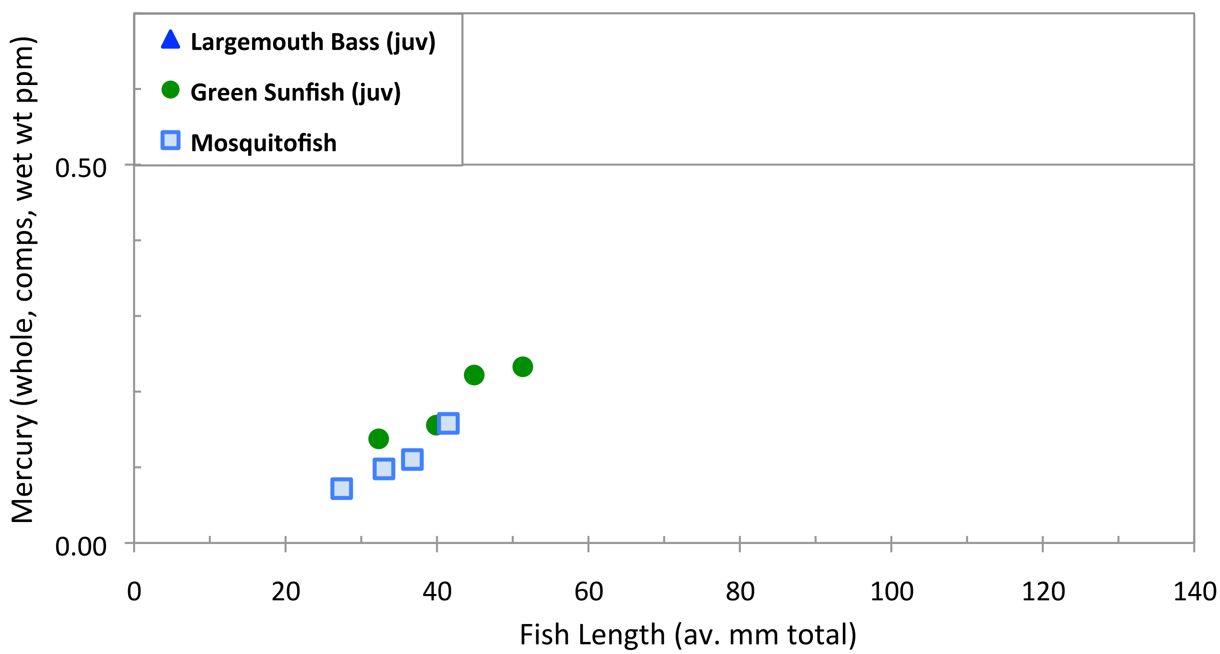

Figure 40. **Syar – West Pond: small, young fish sampled, 2020**
(mercury in whole-body, multi-individual composite samples)

Table 41. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Largemouth Bass (juveniles)							
Syar – West	**2017**	**2**	1	123	27	**0.418**	± 0.030
Syar – West	**2018**	**4**	2	77	6	**0.153**	± 0.024
Syar – West	**2019**	**2**	1	96	11	**0.273**	± 0.006
Syar – West	**2020**	*(none taken)*					
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

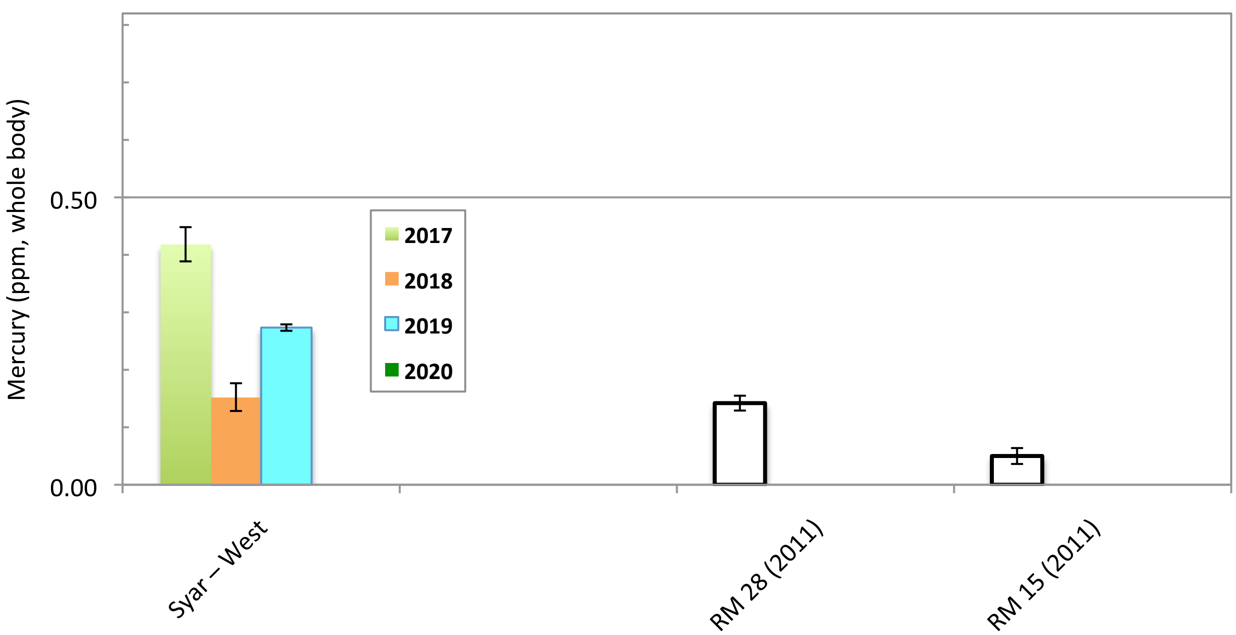

Figure 41. Juvenile Largemouth Bass summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 42. Juvenile Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish (juveniles)							
Syar – West	**2017**	**4**	5-10	45	1.7	**0.237**	± 0.077
Syar – West	**2018**	**4**	2-4	34	0.6	**0.102**	± 0.017
Syar – West	**2019**	**4**	8-10	46	1.5	**0.177**	± 0.010
Bluegill Sunfish (juveniles)							
Syar – West	**2020**	**4**	10-12	42	1.2	**0.187**	± 0.024
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

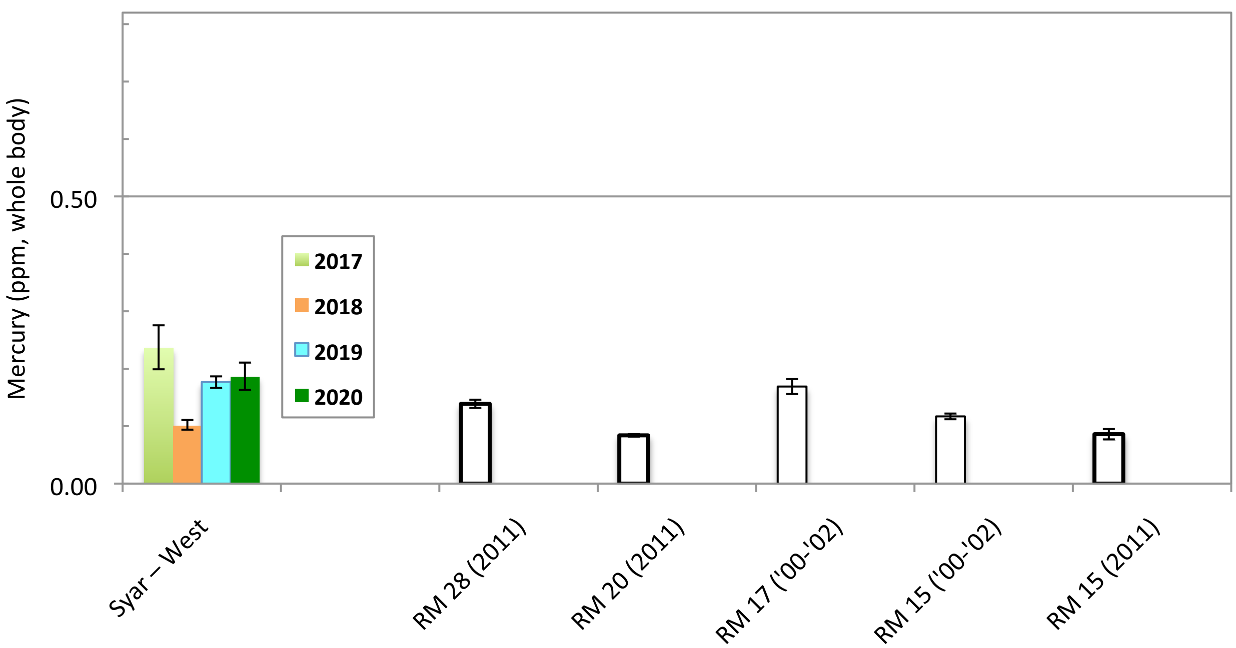

Figure 42. Juv. Green Sunfish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 43. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Mosquitofish							
Syar – West	**2017**	**4**	10	34	0.4	**0.236**	± 0.034
Syar – West	**2018**	**4**	6-7	29	0.3	**0.088**	± 0.012
Syar – West	**2019**	**3**	2-3	36	0.6	**0.165**	± 0.032
Syar – West	**2020**	**4**	8-12	35	0.5	**0.109**	± 0.018
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

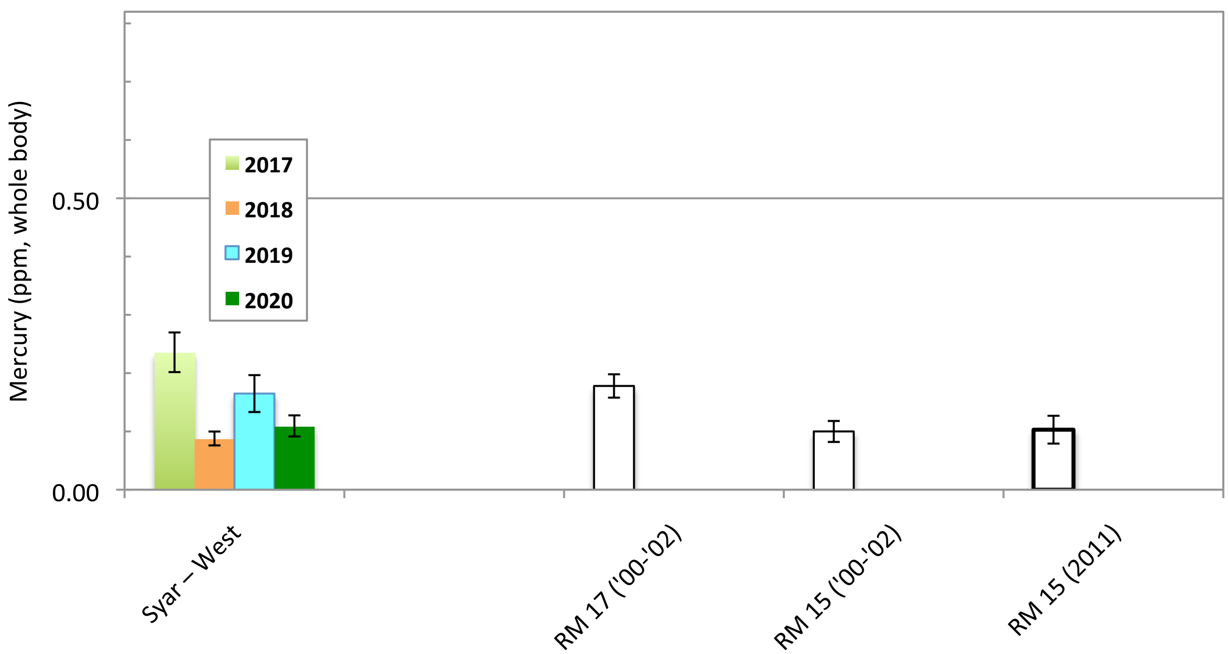

Figure 43. Mosquitofish summary data, and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

7. COMPARISON OF ALL THE MONITORED SITES AND HISTORICAL DATA, BY FISH SPECIES

This section is presented to consolidate the monitoring data and place the various findings into relative context. For each sample type, data are first presented in a table and then graphically with an accompanying figure. These presentations allow the reader (and these researchers) to assess overall trends, across all of the monitored ponds and over time.

Table 44. Largemouth Bass summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Largemouth Bass						
Cemex – Phase 1	**2015**	**18**	305	393	**0.278**	± 0.055
Cemex – Phase 1	**2016**	**20**	313	383	**0.350**	± 0.066
Cemex – Phase 1	**2017**	**17**	299	357	**0.393**	± 0.079
Cemex – Phase 1	**2018**	**20**	298	331	**0.481**	± 0.131
Cemex – Phase 1	**2019**	**20**	280	247	**0.404**	± 0.085
Cemex – Phase 1	**2020**	**20**	267	253	**0.352**	± 0.075
Cemex – Phase 3-4	**2015**	**20**	344	526	**0.840**	± 0.113
Cemex – Phase 3-4	**2016**	**20**	344	557	**0.858**	± 0.139
Cemex – Phase 3-4	**2017**	**20**	334	479	**1.093**	± 0.172
Cemex – Phase 3-4	**2018**	**20**	331	463	**0.918**	± 0.119
Cemex – Phase 3-4	**2019**	**20**	312	402	**0.819**	± 0.195
Cemex – Phase 3-4	**2020**	**20**	310	399	**0.656**	± 0.094
Teichert-Esparto – Reiff	**2017**	**5**	189	78	**1.679**	± 0.180
Teichert-Esparto – Reiff	**2018**	**10**	251	181	**1.997**	± 0.170
Teichert-Esparto – Reiff	**2019**	**10**	295	353	**1.183**	± 0.314
Teichert – Esparto	**2020**	**13**	311	453	**1.238**	± 0.204
Teichert-Woodland – Storz	**2017**	**20**	245	203	**0.657**	± 0.038
Teichert-Woodland – Storz	**2018**	**20**	255	197	**0.611**	± 0.082
Teichert-Woodland – Storz	**2019**	**12**	222	196	**0.218**	± 0.042
Teichert-Woodland – Storz	**2020**	**20**	211	99	**0.193**	± 0.021
Syar – B1	**2015**	**18**	281	355	**1.628**	± 0.332
Syar – B1	**2016**	**20**	318	489	**1.640**	± 0.152
Syar – B1	**2017**	**16**	260	265	**0.904**	± 0.239
Syar – B1	**2018**	**20**	295	335	**0.977**	± 0.198
Syar – B1	**2019**	**20**	307	377	**0.980**	± 0.192
Syar – B1	**2020**	**19**	299	346	**1.095**	± 0.165
Syar – West	**2017**	**17**	283	320	**0.925**	± 0.205
Syar – West	**2018**	**20**	278	292	**0.798**	± 0.229
Syar – West	**2019**	**20**	275	271	**0.672**	± 0.105
Syar – West	**2020**	**19**	295	304	**0.902**	± 0.159

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(Table 44, continued)

Historic/Baseline Data (comparable predatory species)						
Largemouth Bass						
River Mile 28	**2011**	**9**	**199**	**137**	**0.663**	**± 0.116**
Smallmouth Bass						
River Mile 28	**2011**	**7**	**265**	**326**	**0.782**	**± 0.188**
River Mile 20	2000	7	234	183	0.444	± 0.061
River Mile 15	1997	2	383	780	0.939	
Sacramento Pikeminnow						
River Mile 28	**2011**	**10**	**311**	**262**	**0.726**	**± 0.102**
River Mile 20	2000	8	269	147	0.509	± 0.204
River Mile 15	**2011**	**9**	**264**	**145**	**0.327**	**± 0.066**

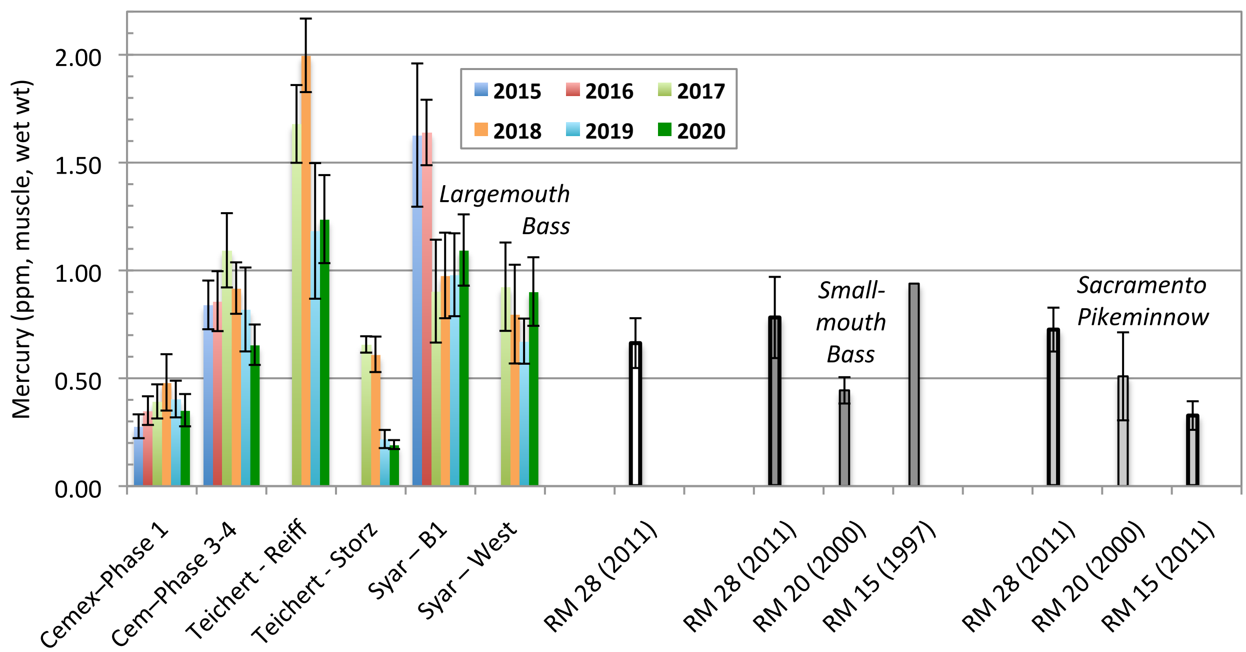

Figure 44. Largemouth Bass summary data, and historic creek comparisons *(mean fillet muscle mercury, with 95% confidence intervals)*

Table 45. Catfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Channel Catfish						
Cemex – Phase 1	**2015**	**2**	595	2,130	**0.198**	
Cemex – Phase 1	**2016**	**2**	412	1,150	**0.100**	
Cemex – Phase 1	**2017**	**2**	531	1,440	**0.236**	
Cemex – Phase 1	**2018**	**3**	533	1,973	**0.337**	± 0.587
	(Catfish – both species – not found at Cemex–Phase 1 since 2018)					
White Catfish						
Cemex – Phase 1	**2016**	**3**	661	2,900	**0.372**	
Cemex – Phase 1	**2017**	**6**	615	2,120	**0.448**	± 0.134
Cemex – Phase 1	**2018**	**1**	398	1115	**0.571**	
Teichert-Esparto – Reiff	**2015**	**20**	347	658	**0.737**	± 0.156
Teichert-Esparto – Reiff	**2016**	**20**	297	341	**0.996**	± 0.153
Teichert-Esparto – Reiff	**2017**	**16**	355	677	**1.287**	± 0.197
Teichert-Esparto – Reiff	**2018**	*(unable to sample in 2018)*				
Teichert-Esparto – Reiff	**2019**	**10**	337	535	**0.637**	± 0.134
Teichert – Esparto	**2020**	**10**	369	742	**0.408**	± 0.123
Historic/Baseline Data						
Channel Catfish						
Rumsey	2000	1	411	565	0.225	
River Mile 28	**2011**	**5**	**239**	**102**	**0.229**	**± 0.102**
River Mile 20	2000	1	368	380	0.225	
River Mile 03	1997	10	336	304	0.174	± 0.019

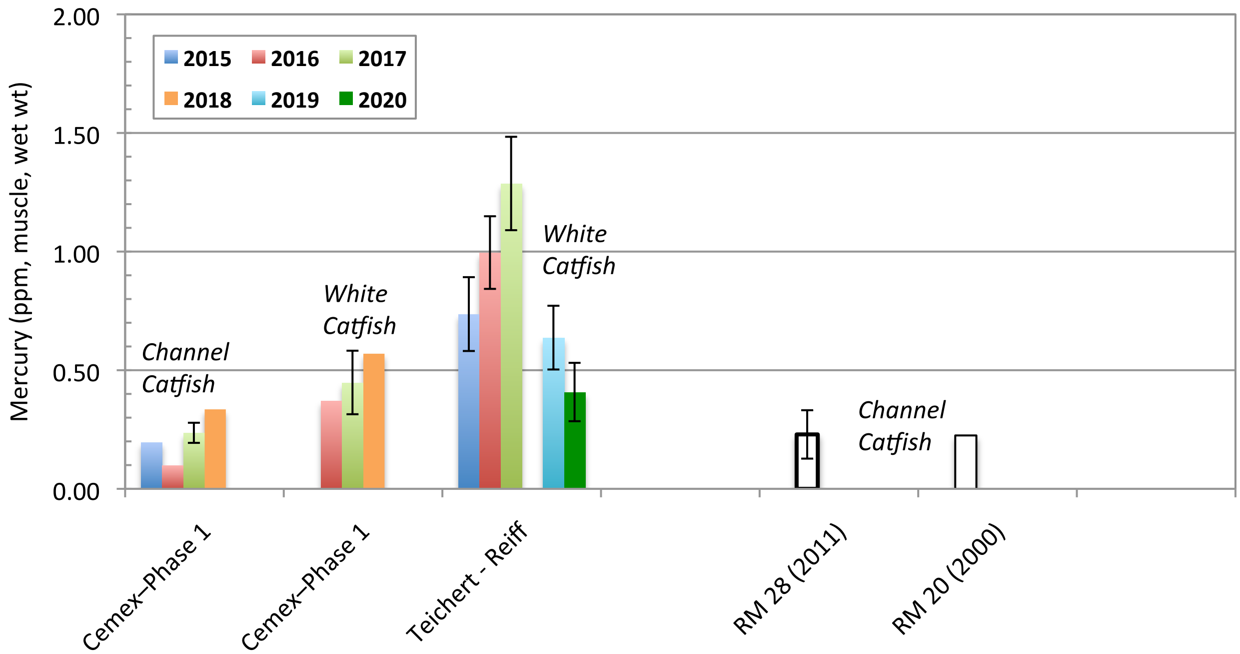

Figure 45. Catfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Table 46. Sunfish summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Green Sunfish *(unless noted Bluegill)*						
Cemex – Phase 1	2017	5	105	35	0.273	± 0.094
Cemex – Phase 1	2018	1	200	165	0.227	
Cemex – Phase 3-4	2015	10	133	67	0.534	± 0.076
Cemex – Phase 3-4	2016	1	101	16	0.382	
Cemex – Phase 3-4	2017	–				
Cemex – Phase 3-4	2018	–				
Teichert-Esparto – Reiff	2015	1	140	40	0.328	
Teichert-Esparto – Reiff	2016	–				
Teichert-Esparto – Reiff	2017	–				
Teichert-Esparto – Reiff	2018	–				
Teichert-Esparto – Reiff	2019	1	106	23	0.373	
Syar – B1	2015	10	118	25	0.777	± 0.086
Syar – B1	2016	1	83	12	1.446	
Syar – B1	2017	–				
Syar – B1	2018	–				
Syar – B1	2019	2	102	17	0.457	
Syar – B1 *Bluegill*	2020	10	157	63	0.602	± 0.072
Syar – West	2017	4	93	12	0.579	± 0.089
Syar – West	2018	–				
Syar – West	2019	1	126	41	0.238	
Syar – West *Bluegill*	2020	10	185	121	0.612	± 0.095
Historic/Baseline Data						
River Mile 28	**2011**	**3**	**139**	**47**	**0.540**	**± 0.124**
River Mile 20	2000	4	132	41	0.271	
River Mile 20	**2011**	**10**	**122**	**31**	**0.138**	**± 0.029**
River Mile 15	**2011**	**10**	**133**	**41**	**0.195**	**± 0.031**

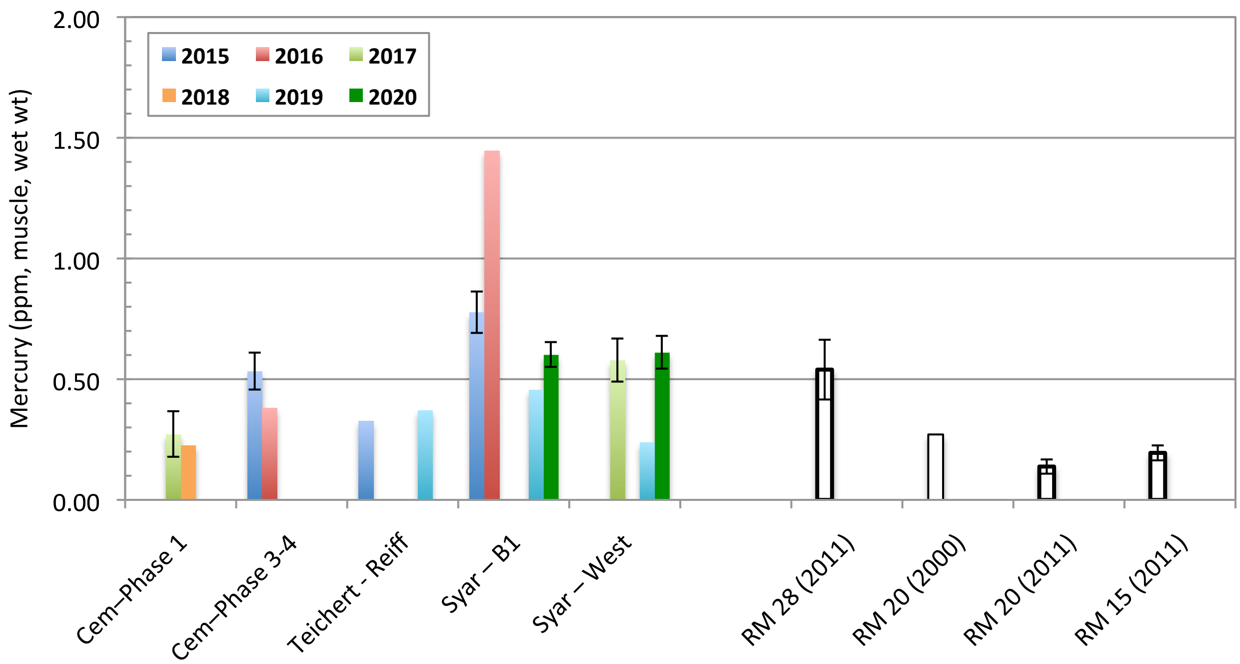

Figure 46. **Sunfish summary data (all sites) and historic creek comparisons**
(mean fillet muscle mercury, with 95% confidence intervals)

Table 47. Carp summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Site	Year	Number of Fish	Av Length (mm total)	Av Weight (grams)	Av Hg (µg/g = ppm, wet wt)	95% C.I.
Carp						
Teichert-Esparto – Reiff	**2015**	**2**	421	918	**0.351**	
Teichert-Esparto – Reiff	**2016**	**5**	430	975	**0.854**	± 0.387
Teichert-Esparto – Reiff	**2017**	**9**	481	1,499	**1.122**	± 0.321
Teichert-Esparto – Reiff	**2018**	*(unable to sample)*				
Teichert-Esparto – Reiff	**2019**	**9**	483	1,475	**0.988**	± 0.279
Teichert – Esparto	**2020**	**7**	381	1,086	**0.636**	± 0.334
Historic/Baseline Data (most comparable species available)						
Sacramento Sucker						
Rumsey	2000	6	328	396	0.198	± 0.113
River Mile 20	2000	5	253	174	0.154	± 0.034
River Mile 15	**2011**	**8**	**276**	**231**	**0.143**	**± 0.011**
River Mile 08	2000	4	319	336	0.339	
River Mile 03	1997	5	343	402	0.263	± 0.068

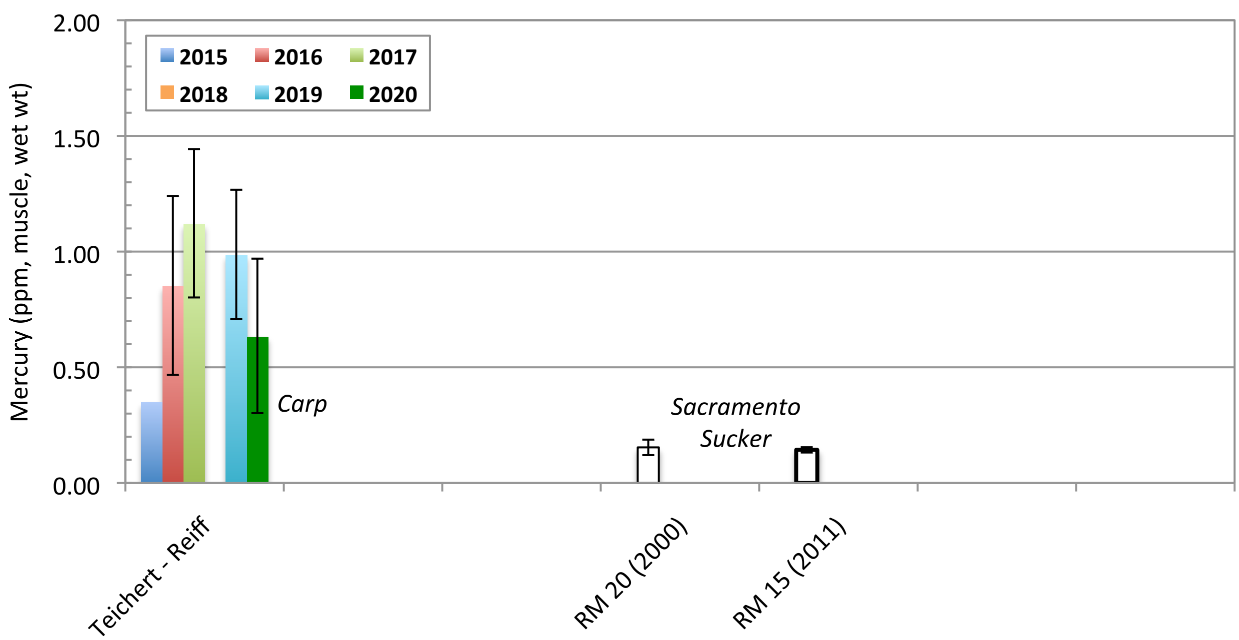

Figure 47. Carp summary data (all sites) and historic creek comparisons
(mean fillet muscle mercury, with 95% confidence intervals)

Small, Young Fish Samples *(note lower concentration scales)*

Table 48. Juvenile Bass summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Cemex – Phase 1	2015	4	8	109	17	0.044	± 0.004
Cemex – Phase 1	2016	4	3	102	17	0.094	± 0.006
Cemex – Phase 1	2017	4	2	117	22	0.146	± 0.011
Cemex – Phase 1	2018	1	1	78	6	0.068	
Cemex – Phase 1	2019	4	4-5	106	17	0.114	± 0.007
Cemex – Phase 1	2020	5	2-4	100	13	0.104	± 0.008
Cemex – Phase 3-4	2015	4	7	108	16	0.334	± 0.026
Cemex – Phase 3-4	2016	4	2	114	18	0.372	± 0.026
Cemex – Phase 3-4	2017	4	2-3	108	16	0.249	± 0.016
Cemex – Phase 3-4	2018	–	–				
Cemex – Phase 3-4	2019	1	1	125	23	0.336	
Cemex – Phase 3-4	2020	1	1	124	23	0.144	
Teichert-Esparto – Reiff	2017	4	1-2	137	32	0.798	± 0.094
Teichert-Esparto – Reiff	2018	4	4-6	111	17	0.445	± 0.069
Teichert-Esparto – Reiff	2019	4	5	107	15	0.297	± 0.010
Teichert – Esparto	2020	4	3	92	9	0.472	± 0.027
Teichert-Woodland – Storz	2017	4	1	143	35	0.337	± 0.030
Teichert-Woodland – Storz	2018	–	–				
Teichert-Woodland – Storz	2019	4	1	130	29	0.131	± 0.036
Teichert-Woodland – Storz	2020	4	1	172	63	0.097	± 0.005
Syar – B1	2015	4	7	159	44	0.589	± 0.015
Syar – B1	2016	4	10	74	5	0.524	± 0.060
Syar – B1	2017	4	1-2	102	18	0.461	± 0.087
Syar – B1	2018	4	2	88	9	0.368	± 0.020
Syar – B1	2019	4	1	87	7	0.338	± 0.021
Syar – B1	2020	4	1	87	9	0.259	± 0.055
Syar – West	2017	2	1	123	27	0.418	± 0.030
Syar – West	2018	4	2	77	6	0.153	± 0.024
Syar – West	2019	2	1	96	11	0.273	± 0.006
Syar – West	2020	4	4-5	106	17	0.114	± 0.007
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**3-5**	**75**	**6**	**0.142**	**± 0.013**
River Mile 15	**2011**	**3**	**1**	**93**	**10**	**0.050**	**± 0.014**

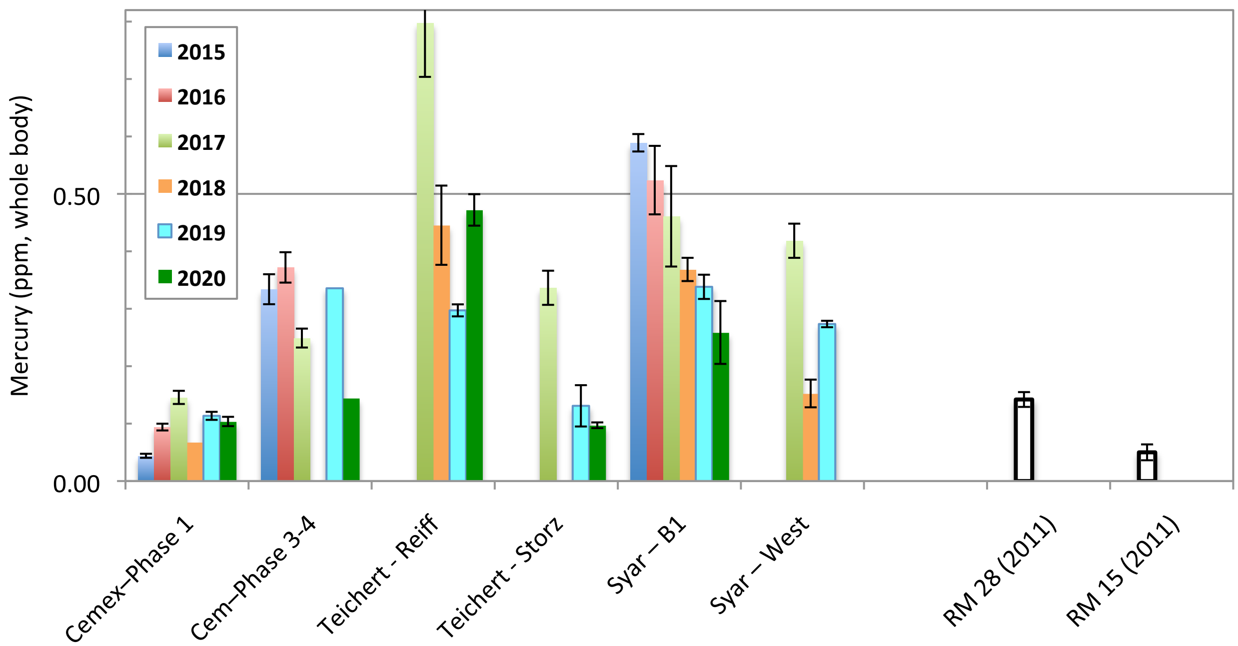

Figure 48. Juvenile Bass summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

Table 49. Juvenile Sunfish summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ (comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Green Sunfish *(unless noted Bluegill)* **– juveniles**							
Cemex – Phase 1	**2017**	**4**	8-10	47	1.9	**0.118**	± 0.011
Cemex – Phase 1	**2018**	**4**	2	51	2.1	**0.035**	± 0.005
Cemex – Phase 1	**2019**	**4**	2-10	44	1.7	**0.089**	± 0.011
Cemex – Phase 1	**2020**	**3**	1-3	50	2.7	**0.089**	± 0.009
Cemex – Phase 3-4	**2015**	**4**	10	47	1.8	**0.275**	± 0.011
Cemex – Phase 3-4	**2016**	**4**	4-5	49	2.0	**0.233**	± 0.013
Cemex – Phase 3-4	**2017**	**4**	2-6	36	0.7	**0.150**	± 0.025
Cemex – Phase 3-4	**2018**	**4**	1	34	0.5	**0.112**	± 0.010
Cemex – Phase 3-4	**2019**	**4**	10	43	1.6	**0.185**	± 0.016
Cemex – Phase 3-4	**2020**	**4**	1-12	38	0.9	**0.117**	± 0.024
Teichert-Esparto – Reiff	**2015**	**–**	1	68	2.7	**0.241**	
Teichert-Esparto – Reiff	**2016**	**–**	–				
Teichert-Esparto – Reiff	**2017**	**–**	–				
Teichert-Esparto – Reiff	**2018**	**4**	2	48	2.3	**0.252**	± 0.010
Teichert-Esparto – Reiff	**2019**	**4**	3-10	41	1.3	**0.187**	± 0.029
Teichert – Esparto	**2020**	**4**	3	35	0.7	**0.230**	± 0.018
Syar – B1	**2015**	**4**	8-9	47	1.7	**0.325**	± 0.048
Syar – B1	**2016**	**4**	4	50	1.9	**0.414**	± 0.038
Syar – B1	**2017**	**4**	6-7	40	1.0	**0.225**	± 0.035
Syar – B1	**2018**	**4**	10	37	0.8	**0.231**	± 0.022
Syar – B1	**2019**	**4**	8-10	45	1.5	**0.245**	± 0.016
Syar – B1 *Bluegill*	**2020**	**4**	12	44	1.3	**0.181**	± 0.018
Syar – West	**2017**	**4**	5-10	45	1.7	**0.237**	± 0.038
Syar – West	**2018**	**4**	2-4	34	0.6	**0.102**	± 0.008
Syar – West	**2019**	**4**	8-10	46	1.5	**0.177**	± 0.010
Syar – West *Bluegill*	**2020**	**4**	10-12	42	1.2	**0.187**	± 0.024
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**4**	**53**	**2.8**	**0.139**	**± 0.007**
River Mile 20	**2011**	**4**	**4**	**58**	**3.4**	**0.084**	**± 0.002**
River Mile 17	2000-2002	8	5-10	41-90	1-6	0.169	± 0.013
River Mile 15	2000-2002	8	4-8	40-87	1-6	0.117	± 0.005
River Mile 15	**2011**	**4**	**4-5**	**56**	**3.1**	**0.086**	**± 0.009**

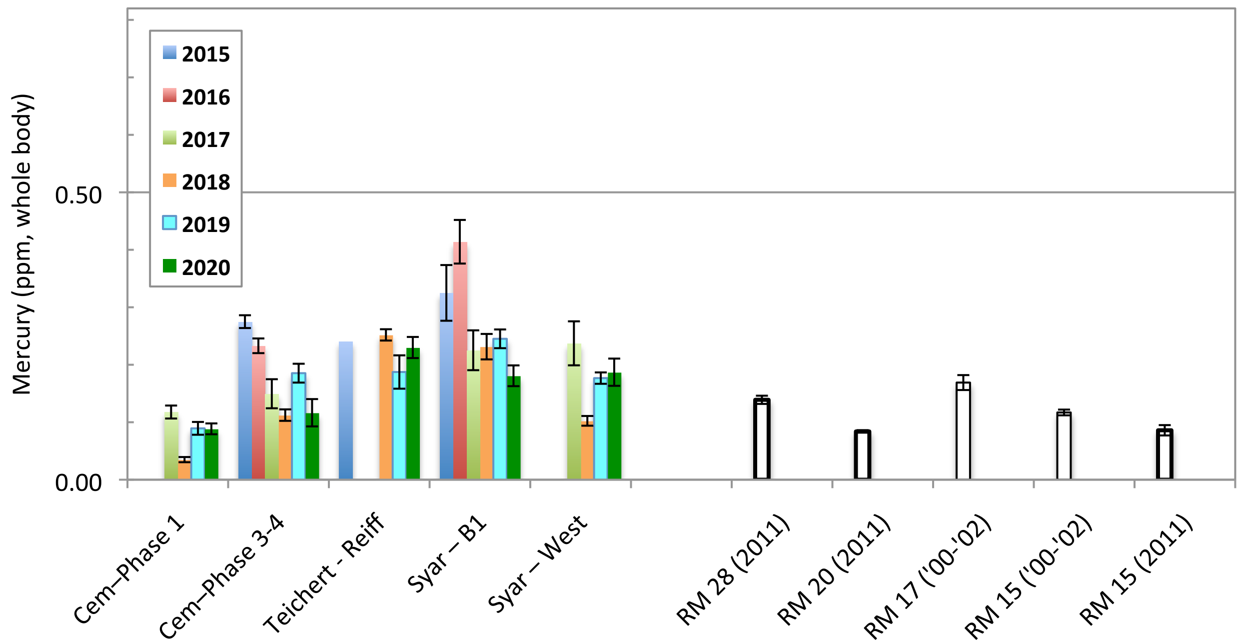

Figure 49. **Juvenile Sunfish summary data (all sites) and historic creek comparisons**
(means of multiple whole-body, multi-individual composite samples)

Table 50. Mosquitofish summary data (all sites) and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	**Year**	**n** (comps)	**n** (inds/ comp)	**Av Lgth** (mm total)	**Av Wt** (grams)	**Hg** (µg/g = ppm, wet wt)	**Std. Error**
Cemex – Phase 1	**2015**	**4**	10	39	0.6	**0.075**	± 0.008
Cemex – Phase 1	**2016**	**4**	10	34	0.4	**0.093**	± 0.019
Cemex – Phase 1	**2017**	**4**	10	33	0.4	**0.135**	± 0.019
Cemex – Phase 1	**2018**	**4**	6-10	34	0.5	**0.083**	± 0.016
Cemex – Phase 1	**2019**	**4**	10	34	0.5	**0.096**	± 0.024
Cemex – Phase 1	**2020**	**4**	12	35	0.5	**0.102**	± 0.021
Cemex – Phase 3-4	**2015**	**4**	10	37	0.6	**0.228**	± 0.029
Cemex – Phase 3-4	**2016**	**4**	10	37	0.6	**0.157**	± 0.019
Cemex – Phase 3-4	**2017**	**4**	6-10	34	0.5	**0.286**	± 0.035
Cemex – Phase 3-4	**2018**	**4**	3-10	34	0.5	**0.203**	± 0.021
Cemex – Phase 3-4	**2019**	**4**	10	35	0.6	**0.183**	± 0.029
Cemex – Phase 3-4	**2020**	**4**	3-12	33	0.4	**0.112**	± 0.018
Teichert-Esparto – Reiff	**2015**	**4**	12	38	0.6	**0.094**	± 0.005
Teichert-Esparto – Reiff	**2016**	**4**	10	36	0.5	**0.212**	± 0.021
Teichert-Esparto – Reiff	**2017**	**–**	–				
Teichert-Esparto – Reiff	**2018**	**4**	10	35	0.5	**0.262**	± 0.026
Teichert-Esparto – Reiff	**2019**	**4**	5-10	33	0.46	**0.222**	± 0.041
Teichert – Esparto	**2020**	**4**	1-12	37	0.7	**0.267**	± 0.033
Teichert-Esparto – Mast	**2017**	**8**	10	35	0.5	**0.312**	± 0.046
Teichert-Esparto – Mast	**2018**	**8**	10	34	0.5	**0.182**	± 0.015
Teichert-Esparto – Mast	**2019**	8	10	34	0.5	0.287	± 0.058
Teichert-Woodland – Storz	**2016**	**4**	10	35	0.5	**0.229**	± 0.054
Teichert-Woodland – Storz	**2017**	**4**	8-10	29	0.2	**0.282**	± 0.011
Teichert-Woodland – Storz	**2018**	**4**	10	30	0.3	**0.087**	± 0.017
Teichert-Woodland – Storz	**2019**	**4**	6-10	33	0.4	**0.200**	± 0.018
Teichert-Woodland – Storz	**2020**	**4**	12	32	0.4	**0.059**	± 0.008
Syar – B1	**2015**	**4**	5-10	31	0.3	**0.268**	± 0.022
Syar – B1	**2016**	**–**	–				
Syar – B1	**2017**	**4**	9-10	35	0.4	**0.309**	± 0.055
Syar – B1	**2018**	**4**	6-9	31	0.4	**0.163**	± 0.028
Syar – B1	**2019**	**3**	1-3	38	0.7	**0.214**	± 0.011
Syar – B1	**2020**	**4**	6-12	34	0.5	**0.130**	± 0.026
Syar – West	**2017**	**4**	10	34	0.4	**0.236**	± 0.034
Syar – West	**2018**	**4**	6-7	29	0.3	**0.088**	± 0.012
Syar – West	**2019**	**3**	2-3	36	0.6	**0.165**	± 0.032
Syar – West	**2020**	**4**	8-12	35	0.5	**0.109**	± 0.018
Historic/Baseline Data							
River Mile 17	2000-2002	13	5-30	26-47	0.2-1.1	0.178	± 0.020
River Mile 15	2000-2002	10	5-30	26-47	0.2-1.0	0.100	± 0.018
River Mile 15	**2011**	**4**	**1-10**	**37**	**0.7**	**0.103**	**± 0.024**

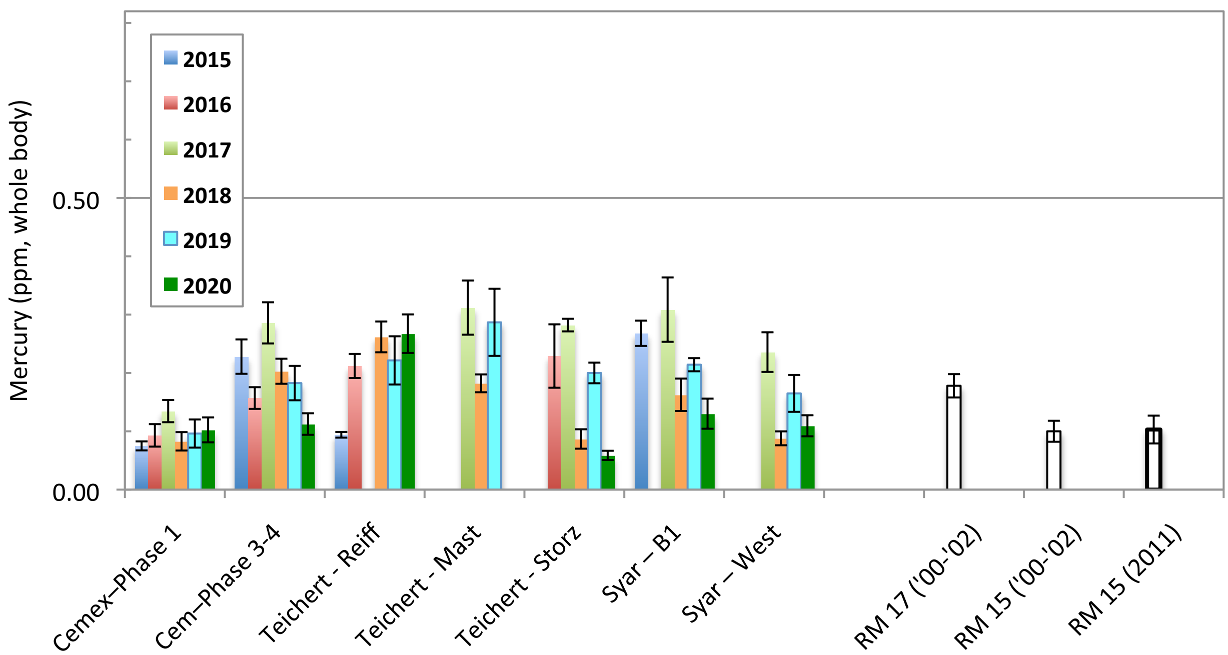

Figure 50. Mosquitofish summary data (all sites), and historic creek comparisons *(means of multiple whole-body, multi-individual composite samples)*

Table 51. Red Shiner summary data (all sites), and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)
'**n**' = *number: number of composite samples; number of individual fish per composite*

Site	Year	n (comps)	n (inds/ comp)	Av Lgth (mm total)	Av Wt (grams)	Hg (µg/g = ppm, wet wt)	Std. Error
Red Shiners							
Teichert-Esparto – Reiff	**2015**	**4**	10	50	1.3	**0.152**	± 0.009
Teichert-Esparto – Reiff	**2016**	**4**	10	47	1.1	**0.412**	± 0.042
Teichert-Esparto – Reiff	**2017**	**4**	10	49	1.1	**0.695**	± 0.070
Teichert-Esparto – Reiff	**2018**	**4**	10	45	0.8	**0.556**	± 0.031
Teichert-Esparto – Reiff	**2019**	*(Shiners not found in 2019 or 2020)*					
Historic/Baseline Data							
River Mile 28	**2011**	**4**	**10**	**48**	**1.0**	**0.242**	**± 0.018**
River Mile 20	2000	3	9	42	0.6	0.166	± 0.002
River Mile 17	2000-2002	11	6-15	27-58	0.2-1.8	0.225	± 0.023
River Mile 15	1997	3	19	37	0.5	0.159	± 0.014
River Mile 15	2000-2002	13	6-12	30-60	0.2-2.0	0.131	± 0.005

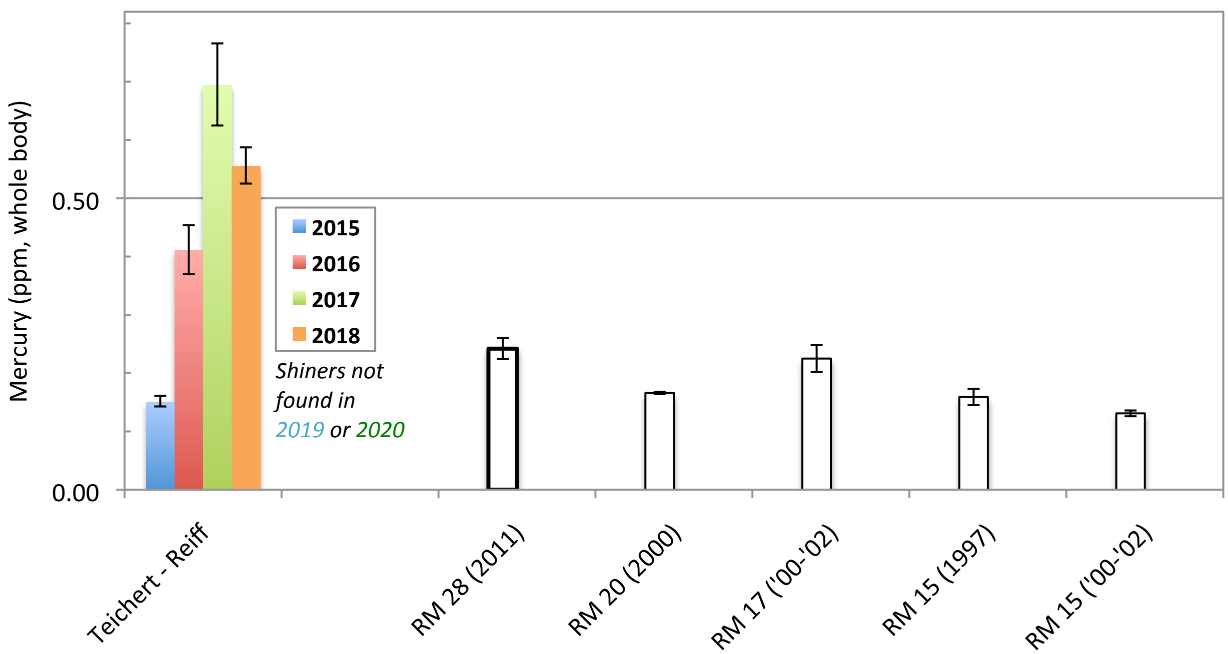

Figure 51. Red Shiner summary data (all sites), and historic creek comparisons
(means of multiple whole-body, multi-individual composite samples)

DISCUSSION AND CONCLUSIONS

The Yolo County Ordinance for mercury in aggregate mining ponds was revised and updated in December 2019 (Yolo County Code 2019). The full, updated text is attached below as Appendix A. Fish monitoring results have been assessed, since 2019, in relation to the updated Ordinance measures. The updated Ordinance calls for action based on three to five years of data, as follows:

> ***If, during the mining phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three of five monitoring years, annual monitoring shall continue for an additional five years, and the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).*** *Sec. 10–5.517(e)(2).*

The "exceeds the ambient mercury level" above refers to whether pond fish mercury levels are found to be significantly elevated above corresponding Cache Creek Baseline samples – in three of five monitoring years. The summary table below shows overall annual results of fish mercury testing in the monitored ponds, in relation to ambient fish mercury levels.

Fish Mercury Monitoring Summary – All Sites, 2015-2020

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr>
<tr><td>Cemex – Phase 1</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td><td>≤</td></tr>
<tr><td>Cemex – Phase 3-4</td><td>></td><td>></td><td>></td><td>></td><td>></td><td>≤</td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td>INC</td><td>></td><td>></td><td>></td><td>></td><td rowspan="2">></td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td>></td><td>INC</td><td>></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td>INC</td><td>≤</td><td>≤</td><td>≤</td></tr>
<tr><td>Syar – B1</td><td>></td><td>></td><td>></td><td>></td><td>></td><td>></td></tr>
<tr><td>Syar – West</td><td></td><td></td><td>></td><td>≤</td><td>></td><td>></td></tr>
</table>

≤ = at or below ambient   INC = inconclusive   > = elevated over ambient

Annual monitoring of fish mercury levels began in 2015 at four aggregate mining ponds: Cemex–Phase 1, Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. By 2018, with four years of data from the initial four monitored ponds, three were found to be elevated in fish mercury in three or more years: Cemex–Phase 3-4, Teichert-Esparto–Reiff, and Syar–B1. These three ponds have remained elevated above baseline through nearly all of the monitoring. The Cemex–Phase 1 Pond, in contrast, has been consistently low in fish mercury (relatively). It was chosen as a control/reference pond, as specified in the ordinance. Beginning in 2018, "expanded analyses" were added to the program at these four ponds and routine fish monitoring was extended by five years.

Three other ponds were added to the fish monitoring in 2017: Teichert-Woodland–Storz, Syar–West, and Teichert-Esparto–Mast. Teichert-Esparto Mast was later combined with Reiff Pond into the current Esparto Pond, which continues to be monitored for fish mercury and expanded analyses. There are now four years of fish data for Teichert-Woodland–Storz and Syar–West. Storz has been identified as another consistently lower mercury site, not requiring expanded analyses other than routine water profiling once per year in fish monitoring years. Syar–West had inconclusive mercury status but now, with three years of elevated fish mercury of the last four, it is flagged for required expanded analyses beginning 2021 and an additional five years of fish testing. Expanded analyses actually began here earlier; Syar–West was tested as a second control/reference pond, important for its depth which more closely matches projected final post-reclamation pond depths at some of the sites. The timelines of water profiling and other project components are summarized in tables at the end of this section.

For the ponds flagged as significantly elevated over ambient in three of five years, the Ordinance states:

... the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g). *Sec. 10–5.517(e)(2).*

The "expanded analysis" tasks are meant to precede and provide guidance for the "preparation of a lake management plan". Because of the complexities of the methylmercury cycle and the unique configuration, depth, chemistry, and biology of each individual pond, additional information is needed to help craft site-specific management approaches that are likely to be effective. The first steps are to 1) broadly characterize the bottom sediments of the pond and 2) initiate seasonal water column profiling of a range of potentially relevant water quality parameters.

1. Characterize pond bottom sediment

For the ponds that have been flagged for expanded analysis and development of lake management plans, and the required control/reference sites, some basic information about the bottom sediments was essential, to see if there are any large differences between the ponds that could help account for the mercury bioaccumulation patterns. Sediment sampling was conducted in Fall 2018 at the 3 ponds identified as elevated in fish mercury at that time, plus the identified control site Cemex–Phase 1. The Syar–West pond was also sampled, making five ponds in total for initial sediment characterization. As specified in the Ordinance, for each pond, six independent bottom samples were taken from locations distributed across the pond, specifically of fine-grained surficial sediments (top 2 cm). These were analyzed for total mercury and organic matter content.

The bottom sediment mercury data ranged between mean levels of 0.266 and 0.518 ppm, across all five ponds tested. These levels were similar to the 0.390 ppm average from the USGS studies in the downstream Cache Settling Basin. There was a small, approximate two-fold range between lowest and highest concentrations. The ponds were elevated above 'clean/background' levels, as is to be expected for this watershed (sediment mercury around upstream source areas ranges into the hundreds of parts per million). The report for the sediment work concluded:

> "... But the two lowest sediment mercury sites, Cemex–Phase 1 and Teichert-Esparto–Reiff, included both the lowest and the highest fish mercury conditions. Clearly, the ranges of sediment mercury levels present in these ponds are <u>all</u> more than enough to potentially lead to elevated fish mercury levels. The low fish mercury at the Cemex–Phase 1 pond and very high fish mercury at Teichert-Esparto–Reiff, with nearly identical sediment mercury at both, strongly suggests that <u>other conditions</u> of the ponds are more important. This is an advance that will help guide potential management directions. These initial sediment characterization tests were looking for potentially dramatic sediment mercury trends that were much higher than baseline and/or vastly different between ponds. That has been ruled out. This points management ideas more toward modification of other pond conditions that

may lead to differences in methylmercury production and transfer, and to the large differences seen in fish mercury levels. The accompanying water column profiling work seeks to identify some of these possible factors."

It is possible that additional or different sediment analyses may be warranted in the future to help determine appropriate management approaches.

2. Initiate water column profiling

For the ponds that have been flagged for expanded analysis and development of lake management plans, and the required control/reference pond, the Ordinance outlines:

The analysis shall include expanded lake water column profiling (a minimum of five profiles per affected wet pit lake plus one or more nonaffected lakes for control purposes) conducted during the warm season (generally May through October) in an appropriate deep profiling location for each pit lake. The following water quality parameters shall be collected at regular depth intervals, from surface to bottom of each lake, following protocols identified in subsection (a): temperature, dissolved oxygen, conductivity, pH and oxidation-reduction potential (ORP), turbidity or total suspended solids, dissolved organic matter, and algal density by Chlorophyll or Phycocyanin.

Water column profiling began in 2018, as described above. The three identified elevated-mercury ponds and the lower-mercury control/reference pond have been tested seasonally, five times per year between May and October. The Syar-West Pond was also studied as a deep pond control, added in 2019; with updated fish mercury status to 'elevated over ambient', profiling will be required there. Profiling continued at these sites in 2020. Results are presented in accompanying water reports. Excerpting from the conclusions of the 2019 water profiling report:

"Some of the greatest accumulations or changes were found in the lower water of ponds that stratified thermally. Most of the monitored ponds were too shallow to stratify completely (isolate water layers from each other) in the warm season but two, Teichert-Esparto–Reiff and Syar–B1, stratified enough for many of the measured water parameters to shift significantly, including oxygen, pH, and ORP, with deep accumulations of turbidity and algal cells."

"Among the three ponds identified as elevated in fish mercury – Syar–B1, Teichert-Esparto–Reiff, and Cemex–Phase 3-4 – there was not a single, consistent trend. While the two most elevated ponds, Syar–B1 and Teichert-Esparto–Reiff have consistently shown evidence of seasonal water column anoxia, that was not the case at Cemex-Phase 3-4. The new data from the much deeper Syar–West pond confirmed it as a site of strong seasonal water stratification and bottom water anoxia (loss of oxygen)."

"At this point with the new water profiling data, seasonal bottom water anoxia – or its absence – appears to be an important link to the observed fish mercury trends. Since seasonal anoxia is known to enhance the production of methylmercury and its movement into fish, management approaches that disrupt that pattern may reduce the problem. This is something to consider for ponds identified as elevated in fish mercury and requiring management. The profiling results to-date support management approaches that could provide summer mixing and the disruption of bottom water anoxia – specifically for ponds that require mercury management and that have seasonal anoxia. The case of Cemex–Phase 3-4 though, with high fish mercury but no seasonal anoxia, is a reminder that there may not be any single 'magic bullet' management approach; different approaches may be needed at different sites. Many different physical, chemical, and biological factors can influence the mercury cycle in each pond. Seasonal anoxia is the most straightforward one to tackle – when it is present. When it isn't, and fish mercury is still elevated, other mechanisms will need to be identified for possible alternate management approaches. This water column profiling is an important step to better understand the options."

———

The fish monitoring itself has also highlighted factors that could be significant for lake management. The bass mercury trend at Teichert–Esparto, in relation to changing prey species, supports the idea that food web structure may significantly impact mercury accumulation in the top predator fish. Additionally, fish mercury trends have been observed over the years in relation to the presence or absence of active mining or processing plant slurry flows. These processes that suspend sediment particles into the water have been associated with declines in fish mercury uptake rather than increases, presumably by placing alternate binding sites into the water for methylmercury, deflecting some of it from foodweb pathways. And, in contrast, clear water conditions with low suspended solids have tended to be associated with relative increases in fish mercury uptake.

Fish monitoring will continue at all of the aggregate mining ponds in the program, as will seasonal water column testing at the designated subset. Ongoing findings will help narrow down management options for the sites requiring lake management plans and action. With three years now of additional information at Cemex–Phase 3-4, Teichert–Esparto, and Syar–B1, it is time (late 2022 at the time of this reporting) to begin developing Lake Management Plans for those sites.

Status of Other Components of the Mercury Monitoring Program

Water Column Profiling *(elevated sites and controls)*

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr>
<tr><td>Cemex – Phase 1 (control)</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Cemex – Phase 3-4</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td rowspan="2">✓</td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Syar – West (deep control)</td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

Bottom Sediment Collections *(single event, elevated sites and controls)*

<table>
<tr><th>Pit Sites</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr>
<tr><td>Cemex – Phase 1 (control)</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td></tr>
<tr><td>Cemex – Phase 3-4</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td></tr>
<tr><td>Teichert-Esparto – Reiff</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td></tr>
<tr><td>Teichert-Esparto – Mast</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Teichert-Woodland – Storz</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Syar – B1</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td></tr>
<tr><td>Syar – West (deep control)</td><td></td><td></td><td></td><td colspan="2">✓</td><td></td></tr>
</table>

Reports Completed

<table>
<tr><th>Report</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr>
<tr><td>Fish Mercury Monitoring</td><td>Final</td><td>Final</td><td>Final</td><td>Final</td><td>Final</td><td>Draft</td></tr>
<tr><td>Water Column Profiling</td><td></td><td></td><td></td><td>Final</td><td>Final</td><td>Draft</td></tr>
<tr><td>Bottom Sediments (1x)</td><td></td><td></td><td></td><td colspan="2">Final</td><td></td></tr>
</table>

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APPENDIX A

Yolo County, CA Code of Ordinances

Sec. 10-4.420.1 – 10-5.517 Mercury Bioaccumulation in Fish
– December 2019 Update and Revision –

Yolo County Mining Ordinance, Sec.10-4.420.1 Mercury Bioaccumulation in Fish.

Each mining area to be reclaimed to a permanent lake as part of each approved long-range mining plan shall be evaluated annually by the operator for five years after the pit fills with groundwater with an intensive fish mercury monitoring program described in Section 10-5.517 of the Reclamation Ordinance.

Reclamation Ordinance, Sec. 10-5.517. Mercury bioaccumulation in Fish.

As part of each approved long-term mining plan involving wet pit mining to be reclaimed to a permanent pond, lake, or water feature, the operator shall maintain, monitor, and report to the Director according to the standards given in this section. Requirements and restrictions are distinguished by phase of operation as described below.

(a) Mercury Protocols. The Director shall issue and update as needed "Lower Cache Creek Off-Channel Pits Mercury Monitoring Protocols" (Protocols), which shall provide detailed requirements for mercury monitoring activities. The Protocols shall include procedures for monitoring conditions in each pit lake, and for monitoring ambient mercury level in the lower Cache Creek channel within the CCAP planning area, as described below. The Protocols shall be developed and implemented by a qualified aquatic scientist or equivalent professional acceptable to the Director. The Protocols shall identify minimum laboratory analytical reporting limits, which may not exceed the applicable response threshold identified in subsection (e) below. Data produced from implementing the Protocols shall meet or exceed applicable standards in the industry.

(b) Ambient Mercury Level. The determination of the ambient or "baseline" fish mercury level shall be undertaken by the County every ten years in years ending in 0. This analysis shall be undertaken by the County for use as a baseline of comparison for fish mercury testing conducted in individual wet mining pits. The work to establish this baseline every ten years shall be conducted by a qualified aquatic systems scientist acceptable to the Director and provided in the form of a report to the Director. It shall be paid for by the mining permit operators on a fair-share basis. The results of monitoring and evaluation of available data shall be provided in the report to substantiate the conclusions regarding ambient concentrations of mercury in fish within the lower Cache Creek channel within the CCAP planning area.

(c) Pit Monitoring.

(1) Mining Phase (including during idle periods as defined in SMARA). The operator shall monitor fish and water column profiles in each pit lake once every year during the period generally between September and November for the first five years after a pit lake is created. Fish monitoring should include sport fish where possible, together

with other representative species that have comparison samples from the creek and/or other monitored ponds. Sport fish are defined as predatory, trophic level four fish such as bass, which are likely to be primary angling targets and have the highest relative mercury levels. The requirements of this subsection apply to any pit lake that is permanently wet and navigable by a monitoring vessel. If, in the initial five years after the pit lake is created, the applicable response threshold identified in subsection (e) is exceeded in any three of five monitoring years, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(2) Reclamation Phase. No monitoring is required after mining has concluded, during the period that an approved reclamation plan is being implemented, provided reclamation is completed within the time specified by SMARA or the project approval, whichever is sooner.

(3) Post-Reclamation Phase. After reclamation is completed, the operator shall monitor fish and water column profiles in each pit lake at least once every two years during the period of September-November for ten years following reclamation. Monitoring shall commence in the first calendar year following completion of reclamation activities. If fish monitoring results from the post-reclamation period exceed the applicable response threshold described in subsection (e) or, for ponds that have implemented mitigation management, results do not exhibit a general decline in mercury levels, the operator shall, solely at their own expense, undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(4) Other Monitoring Obligation. If monitoring conducted during both the mining and post-reclamation phase did not identify any exceedances of the ambient mercury level for a particular pit lake, and at the sole discretion of the Director no other relevant factors substantially support that continued monitoring is merited, the operator shall have no further obligations.

(d) Reporting.

(1) Pit Monitoring Results. Reporting and evaluating of subsection (c) pit monitoring results shall be conducted by a qualified aquatic scientist or equivalent professional acceptable to the Director. Monitoring activities and results shall be summarized in a single report (addressing all wet pit lakes) and submitted to the Director within six months following each annual monitoring event. The report shall include, at a minimum: (1) results from subsection (b) (pit monitoring), in relation to subsection (a) (ambient mercury levels).

(2) Expanded Analysis Results. Reporting and evaluation of subsection (f) expanded analysis shall be conducted by a qualified aquatic scientist or equivalent professional acceptable to the Director. Results shall be summarized in a single report (addressing all affected wet pit lakes) and submitted to the Director within six months following

each annual monitoring event. The report shall include, at a minimum, the results of the expanded analysis undertaken pursuant subsection (f).

(3) Data Sharing. For pit lakes open to the public, the Director may submit the data on mercury concentrations in pit lake fish to the state Office of Environmental Health Hazard Assessment (or its successor) for developing site-specific fish consumption advisories.

(e) Response Thresholds.

(1) Fish Consumption Advisory. If at any time during any phase of monitoring the pit lake's average sport fish tissue mercury concentration exceeds the Sport Fish Water Quality Objective, as it may be modified by the state over time (as of 2019, the level was 0.2 mg/kg), the operator shall post fish consumption advisory signs at access points around the lake and around the lake perimeter. Catch-and-release fishing may still be allowed. Unless site-specific guidance has been developed by the state's Office of Health Hazard Assessment or the County, statewide fish consumption guidance shall be provided.

(2) Mining Phase Results. If, during the mining phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three of five monitoring years, annual monitoring shall continue for an additional five years, and the operator shall undertake expanded analysis pursuant to subsection (f) and preparation of a lake management plan pursuant to subsection (g).

(3) Post-Reclamation Phase Results. If during the first ten years of the post-reclamation phase of monitoring, the pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three of five monitoring years, biennial monitoring shall continue for an additional ten years, and the operator shall undertake expanded analysis pursuant to subsection(f) and preparation of a lake management plan pursuant to subsection (g).

(f) Expanded Analysis.

(1) General. If during the mining or post-reclamation phase, any pit lake's average fish tissue mercury concentration exceeds the ambient mercury level for any three years, the operator shall undertake expanded analyses. The analysis shall include expanded lake water column profiling (a minimum of five profiles per affected wet pit lake plus one or more nonaffected lakes for control purposes) conducted during the warm season (generally May through October) in an appropriate deep profiling location for each pit lake. The following water quality parameters shall be collected at regular depth intervals, from surface to bottom of each lake, following protocols identified in subsection (a): temperature, dissolved oxygen, conductivity, pH and oxidation-reduction potential (ORP), turbidity or total suspended solids, dissolved organic

matter, and algal density by Chlorophyll or Phycocyanin. The initial analysis shall also include one-time collections of fine grained (clay/silt) bottom sediments from a minimum of six well distributed locations for each affected lake, and from one or more non-affected lakes for control purposes, to be analyzed for mercury and organic content.

(2) Scope of Analysis. The purpose of the expanded analyses is to identify and assess potential factors linked to elevated methylmercury production and/or bioaccumulation in each pit lake. The scope of the expanded analyses shall include monitoring and analysis appropriate to fulfill this purpose, invoking best practices in the industry. In addition to the analyses described in subsection (f)(1) above, the analysis should also consider such factors as: electrical conductivity, bathymetry (maximum and average depths, depth-to-surface area ratios, etc.), and trophic status indicators (concentrations, Secchi depth, chlorophyll a, fish assemblages, etc.). Additional types of testing may be indicated and appropriate if initial results are inconclusive.

(3) Use of Results. The results of the expanded analyses undertaken pursuant to this subsection shall be used to inform the preparation of a lake management plan described below under subsection (g).

(g) Lake Management Activities

(1) General. If monitoring conducted during the mining or post-reclamation phases triggers the requirement to undertake expanded analysis and prepare and implement a lake management plan, the operator shall implement lake management activities designed by a qualified aquatic scientist or equivalent professional acceptable to the Director, informed by the results of subsection (f). Options for addressing elevated mercury levels may include (A) and/or (B) below at the Director's sole discretion and at the operator's sole expense.

(A) Lake Management Plan. Prepare a lake management plan that provides a feasible, adaptive management approach to reducing fish tissue mercury concentrations to at or below the ambient mercury level. Potential mercury control methods could include, for example: addition of oxygen to or physical mixing of anoxic bottom waters; alteration of water chemistry (modify pH or organic carbon concentration); and/or removal or replacement of affected fish populations. The lake management plan may be subject to external peer review at the discretion of the Director. Lake management activities shall be appropriate to the phase of the operation (e.g., during mining or post-reclamation). The Lake Management Plan shall include a recommendation for continued monitoring and reporting. All costs associated with preparation and implementation of the lake management plan shall be solely those of the operator. Upon acceptance by the Director, the operator shall immediately implement the plan. The lake management plan shall generally be implemented within three years of reported results from the expanded analyses resulting from subsection (f). If lake management does not achieve

acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator may prepare an alternate management plan with reasonable likelihood of mitigating the conditions.

(B) Revised Reclamation Plan. As an alternative to (A), or if (A) does not achieve acceptable results and/or demonstrate declining mercury levels after a maximum of three years of implementation, at the sole discretion of the Director, the operator shall prepare and submit revisions to the reclamation plan (including appropriate applications and information for permit amendment) to fill the pit lake with suitable fill material to a level no less than five (5) feet above the average seasonal high groundwater level, and modify the end use to agriculture, habitat, or open space at the discretion of the Director, subject to Article 6 of the Mining Ordinance and/or Article 8 of the Reclamation Ordinance as may be applicable.

(2) Implementation Obligations.

(A) If a lake management plan is triggered during the mining or post-reclamation phase and the subsequent lake management activities do not achieve acceptable results and/or demonstrate declining mercury levels, the operator may propose different or additional measures for consideration by the Director and implementation by the operator, or the Director may direct the operator to proceed to modify the reclamation plan as described in subsection (g)(1)(B).

(B) Notwithstanding the results of monitoring and/or lake management activities during the mining phase, the operator shall, during the post-reclamation phase, conduct the required ten years of biennial monitoring.

(C) If monitoring conducted during the post-reclamation phase identifies three monitoring years of mercury concentrations exceeding the ambient mercury level, the operator shall implement expanded analyses as in subsection (f), to help prepare and implement a lake management plan and associated monitoring.

(D) If subsequent monitoring after implementation of lake management activities, during the post-reclamation phase, demonstrates levels of fish tissue mercury at or below the ambient mercury level for any three monitoring years (i.e., the management plan is effective), the operator shall be obligated to continue implementation of the plan and continue monitoring, or provide adequate funding for the County to do both, in perpetuity.

APPENDIX B

PHOTOS FROM
THE FALL 2020 FISH MONITORING

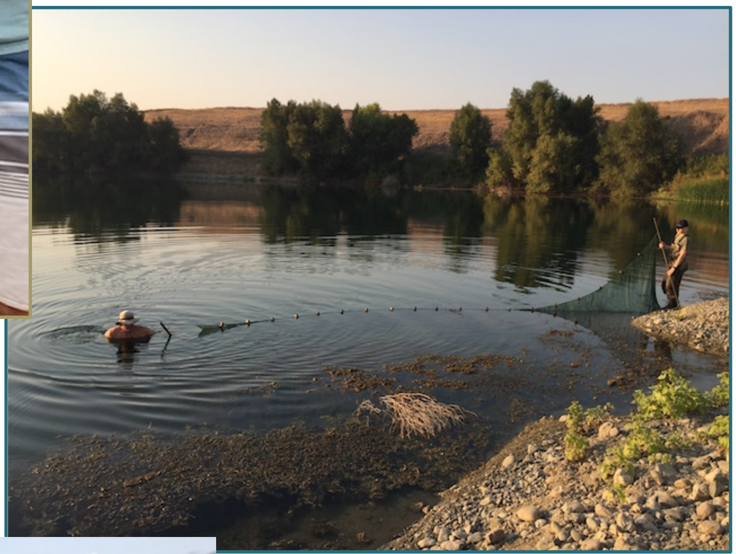
GENERAL FIELD WORK, AND EXAMPLES OF MAIN ADULT FISH

Largemouth Bass; measuring length

Weighing – White Catfish

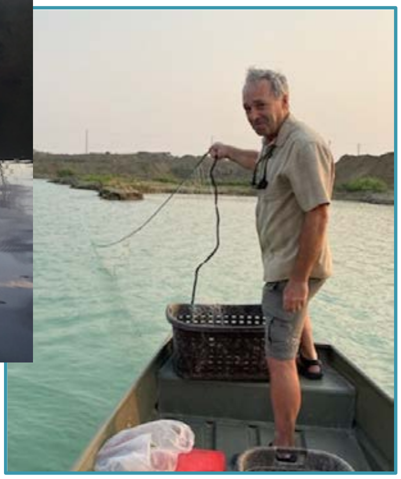
Adult Sunfish – Bluegill

Baited set-lines for catfish



Wade-seining for small fish

Angling for bass at key times



Gill-netting for some large fish

On-site field dissection of small analytical pieces of fillet muscle; large fish released in good condition

Muscle sample into pre-weighed vial; stored on ice in field.

On return, careful re-weigh of vial with sample, to get exact sample weight.

Then into lab freezer, until mercury analysis

CEMEX – PHASE 1 POND

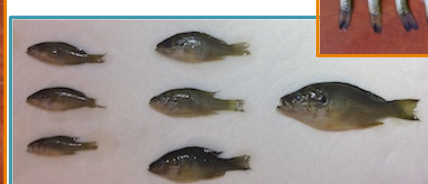
Help with boat access

Seining for small fish

Adult Largemouth Bass (some)

Small fish samples

juvenile Bass



juvenile Green Sunfish

Mosquitofish

CEMEX–PHASE 3-4 POND

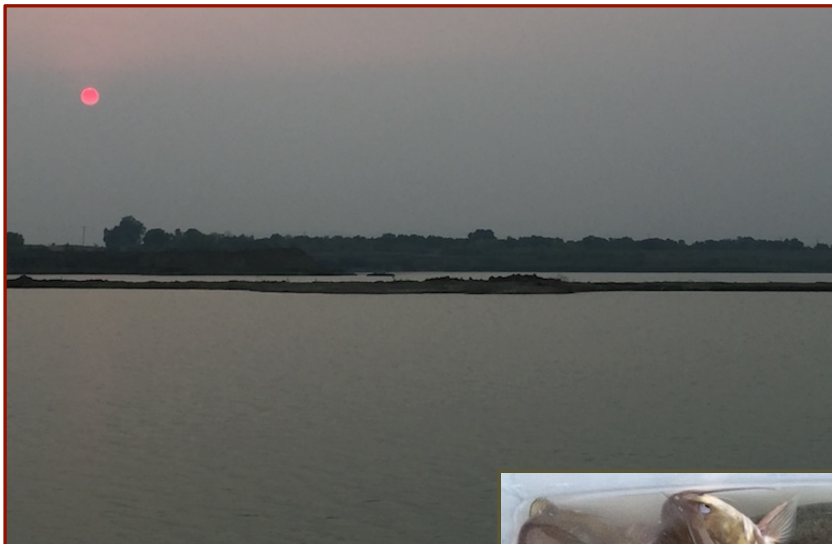
Adult Largemouth Bass

Small fish samples

juvenile
Green Sunfish
and Bass

Mosquitofish

TEICHERT– ESPARTO POND (formerly Reiff + Mast)



Major fires nearby for
much of 2020 sampling season

White Catfish, bass

Carp, bass

Some of the 2020 Largemouth Bass

Collecting White Catfish,
with baited setline

Shore seining

– *Small fish* –

Mosquitofish

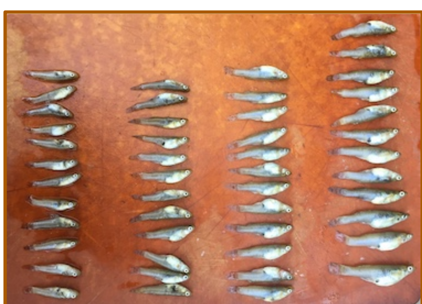
Juvenile Bass

Juvenile Green Sunfish

TEICHERT-WOODLAND – STORZ POND

Drought conditions lowered water level here

Collecting Bass

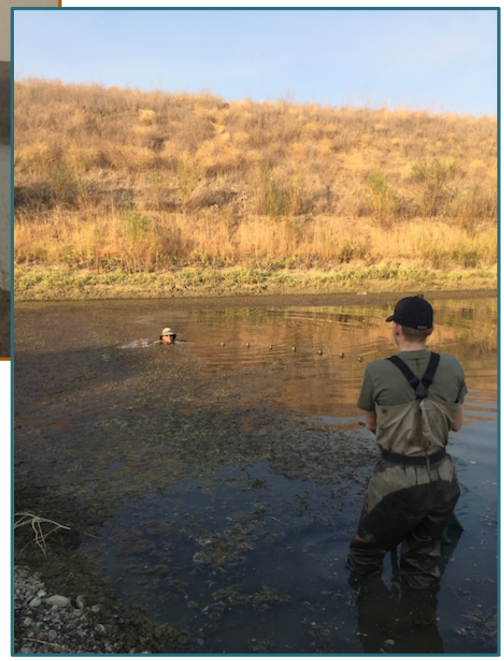


Mosquitofish

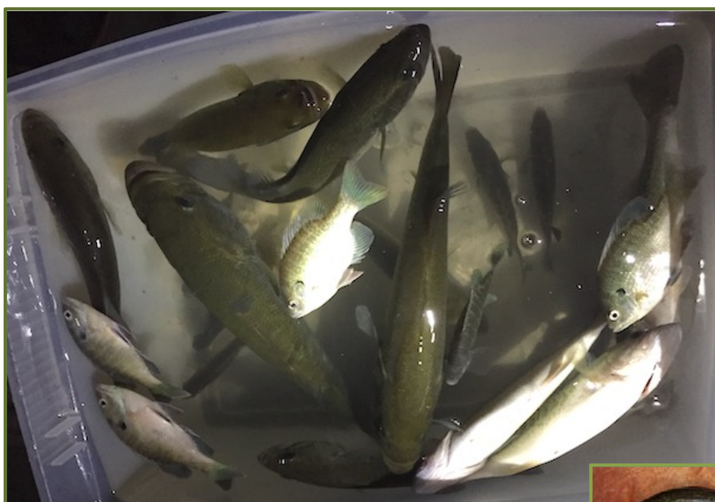
Juvenile Bass

SYAR–B1 POND

Fire smoke



Seining for small fish



Adult Largemouth Bass and Bluegill

Small fish:
juvenile Bluegill, Bass,
Mosquitofish (left to right)

SYAR–WEST POND

Largemouth Bass

Adult Bluegill Sunfish

Juvenile Bluegill

Mosqutofish